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EDITORIAL

SURGICAL CONSCIENCE

CONSIDERING the great strides made by medical education during recent years, it must be admitted that inevitably men are graduated from medical college without adequate training, especially in surgical technic. Many of these embryonic doctors have already become obsessed with the desire to become immediately a Specialist. They probably know little of diagnostic procedures and less of laboratory medicine and its technic. They have no realization of the fact that the life of a trained surgeon begins at forty.

There are many reasons, much too complex and numerous to cite in full, for this distressing lack of preparation and inadequate knowledge on the part of our young doctors.

Sometimes small hospitals are established without adequate funds or equipment for proper medical service, to say nothing of a good surgical department. Here is another sort of opportunity for our poorly trained, inexperienced young doctor. Because he "comes cheap," he is engaged to do surgical work in such an institution.

Or in some of our larger medical institutions where, either from lack of time or laxity, or want of a "surgical conscience" on the part of those in charge, the interns are given inadequate supervision, permitted too great latitude, or admitted to service without sufficient investigation of their preparation for medical work and other qualifications.

A Case in Point. An illustration of what may happen in a high grade medical institution, and through no fault of any particular individual or group of individuals, is recounted in Dr. John Brooks Wheeler's recently published "Memoirs of a Small Town Surgeon." Although the incident occurred a good many years ago and in a great hospital which today would certainly never be guilty of the slightest lapse from its high medical standards, nevertheless the story still stands as a good example of the trouble that can arise from an

ungraded intern service when a young and inexperienced but perfectly well meaning embryonic medico has to assume responsibility in treating a patient in the absence of his superiors. The incident also illustrates the danger of experimenting with new or inadequately tested therapeutic measures.

This briefly is Dr. Wheeler's story: A ward patient who had undergone a minor operation suddenly developed acute nephritis with general dropsy. The chief surgeon was absent, also the hospital superintendent. A messenger was quickly dispatched for the former, and meanwhile palliative measures were instituted. But the patient relapsed into a comatose state followed by convulsions. Dr. Wheeler, at the time an intern in the hospital, decided that the case was desperate and immediate action necessary. He knew that profuse sweating would give more immediate relief than anything else, so decided to administer a hypodermic injection of one-tenth of a grain of pilocarpin, a drug at that time but recently introduced and little used, and about which not much was known. In a few moments the patient emerged from his coma, began to perspire profusely, and seemed on the point of rallying a bit in spite of great weakness and a poor pulse.

When the chief surgeon had been reached by the messenger, and had returned to the hospital after more than an hour's absence, he was taken by young Wheeler to see the patient. Doctor Wheeler writes:

> As we stood by the bedside in the open ward, with the nurses and all the patients in plain sight and clear hearing, he asked me to tell him all about it. I proceeded to do so, but when I got to the pilocarpin he exclaimed, 'What! You took it upon yourself to give him pilocarpin?' 'Yes, sir,' I said. 'There was no one here for me to refer to, and the patient's condition seemed so very bad that I thought he would die unless the promptest relief was given.'
>
> Thereupon, before all the audience and close to the patient himself, who was perfectly conscious by this time, he gave me a tremendous call-down, asking if I didn't know that pilocarpin was a powerful heart depressant, saying that any one so young and inexperienced as I was had no business to administer such a dangerous drug, that house-pupils were not to take it upon themselves to prescribe anything beyond cathartics and anodynes, and that there were other things that I could have done instead of giving the pilocarpin. . . .
>
> I suppose he feared that if he didn't sit on me pretty hard, I might be prescribing anything and everything that came into my head for all the patients, for whose treatment he and not I was responsible. I realized that fact, and I don't think there was much danger of my doing as he may have feared, for it was only on account of the extremeness of the emergency that I ventured to give the pilocarpin. Nevertheless, it was well enough to impress upon me that the patients under my care were Dr. Porter's and not mine, and that it was for him to order the treatment and for me to carry out his orders to the best of my ability. . . . This is a good example of the trouble that can arise from an ungraded intern service. Dr. Porter's statement that I was too inexperienced to be giving drugs like pilocarpin was perfectly correct. But if the service had been better organized, such a case would not have been left entirely in the hands of so inexperienced a man. If there had been a senior intern and a house surgeon ahead of me in the service, such a patient would have been in their charge, and their longer hospital experience would have taught them what their chief wanted them to do in such an emergency.

Qualifications of a Surgeon. These are too well known to warrant detailed discussion, but how often is their vital need disregarded or recognition of their lack in a particular individual clouded by a "pull," or by a brilliant but superficial personality, or perhaps a clever ability to "get away with it" in the matter of securing a responsible position on the part of our untrained and inexperienced young Dr. Medico. Because all these things do happen in the profession, physical fitness, proper temperamental qualifications for doing surgical work, adequate education and practical training, hospital experience, records of internship, assistantship, and

institutional residency, are the only reliable bases for judging candidates for their fitness to take up that great branch of medical science, specialization in surgery.

Meditation before operating on the part of the surgeon who is to perform the operation is another procedure no less important than proper operative technic or suitable postoperative care. By meditation before operating we mean the taking, and careful study and interpretation, of all possible diagnostic steps, their employment as laboratory aids before operation, and the drawing of logical conclusions as to the best methods, procedures, and probable contingencies in the operation to come. Radiographic students should be made, an exhaustive physical examination if necessary, and all other means employed to enable the surgeon to acquire a complete understanding, so far as is possible, of the condition to be operated, in its pathological, anatomical and physiological aspects. Do your findings show that there will be expectancy of a clean wound?— or otherwise? Upon the completeness of these findings, and the conclusions you draw from them, will rest the success or failure of your chosen operative procedure, each individual step of which should be anticipated by you before you begin to work on the patient. One of the most important of these considerations, it goes without saying, is choice of the proper anesthesia, general, spinal, local or what?

The Operating Room. Largely as the human element enters into the requirements for successful operating, they are not the only considerations in the problem. The conditions under which the operation takes place are of the utmost significance, not only to the patient, but also to the surgeon, nurses, and other staff assistants whose presence at the operation may be necessary.

First, the operating room must provide the proper physical conditions, environment and atmosphere. For convenience, it should be near the surgery and anesthesia department. Adequate central lighting directly above the operating table is a prime necessity. Most of all, the room must be quiet and undisturbed by the passing to and fro of persons on duty. Hearing and seeing doctors and nurses hustling about in their white uniforms, always rather forbidding-looking to the poor patient, is sure to excite, then depress him, and also make for nervousness and lack of poise on the part of the staff. The period immediately preceding an operation should be for all concerned a time of quiet, relaxation and self control to insure the best results in the task to come.

Personnel. The service of a trained anesthetist in the operating room is indispensable to the surgeon. Without such assistance, how often is he disturbed and distracted, his patience tried, his valuable time wasted, his technic hampered, and other obstacles encountered, such as faulty anesthetic procedure, incomplete relaxation of the patient, reflex vomiting, etc., until not only the surgeon but all his helpers work in a state of nervous tension and irritability which may be detrimental to the outcome of the operation and the recovery of the patient.

Another most important functionary essential to every good operating room is the operating room nurse. We might almost say that upon her fitness and ability depends largely the success or failure of the operation. She must inspire confidence and the necessary feeling of ease, sureness and relaxation in her chief by providing him with the underlying certainty that *everything* has been prepared under her competent supervision to make for the best possible operating conditions. The room and all its furnishings are spotless, shining and sterile, the linen, drapes, instruments and other details. Every step of the operative procedure has been foreseen and arranged. She makes herself the surgeon's calm, intelligent and competent helper, anticipating his every need, standing at his side, a very spirit of immaculate cleanliness, wholesomeness and poise. In this day and time it goes without saying

that the cult of cleanliness and its application to every detail of medical practice, including the scrupulous care of the person, especially the hands, the sterilization of gloves, instruments, masks, garments and other accessories of the hospital, has assumed almost a religious significance in the mind of the conscientious surgeon. He believes and practices the belief, that cleanliness in truth is next to godliness.

Prevention of Preoperative Infections. The keynote to such prophylaxis is to give all respect to tissues. In joint surgery, including the long bones, hip, knee, elbow joints, the most rigid asepsis is essential and more speed is required than in general surgical procedures. Every step of surgical operations on joints should be planned ahead so as to cause the least possible trauma. Open operations require exercise of the keenest judgment on the part of the surgeon. Again let us emphasize the great importance of careful preliminary contemplation of the case in all its aspects, including the kind of anesthesia to be employed, the time risk, the various surgical steps of the operation to come, etc. A splendid rule is to select true and tried methods and scrupulously follow them. Be very careful about experimenting with new ideas and doubtful procedures.

Abdominal surgery requires the suitable gentle approach, inspection of the condition to be operated, and removal of diseased tissue with no excess trauma, not forgetting to conserve specimens for culture and biopsy. Such operations, because of their elaborate character demand the greatest respect for the organs involved, especially the viscera, which should always be handled, if at all, with the greatest care and tenderness, such as shown toward a newborn baby. Never run undue risks or jeopardize the life of the patient by prolonged explorations, especially in cases of malignancy, which absolutely preclude all slashing or other methods provocative of trauma.

Nerve and tendon surgery requires the utmost patience, as well as a complete knowledge of and acquaintance with nerve and blood vessel anatomy. In such procedures also respect for end results and careful preliminary consideration of future contingencies are of paramount importance.

Orthopedic surgery permits a slightly different approach and preparation for action. Here, the type of operation is often elective and so can be better planned. In such operations, time is frequently abundant, each step leading logically to the next, being the sequel of the preceding one. Also there is usually a profusion of laboratory material as roentgenograms, photographs, casts, etc., for consideration of the case. To orthopedic surgery, particularly, may be applied that telling phrase recently originated by the famous British surgeon, Lord Moynihan, "Surgery to prevent surgery," which has become one of the watch words of the profession. The current progress toward improvement of surgical procedures for the purpose of forestalling future operations which may be of a more serious or complicated nature is obvious to every member.

Yet let us not forget that, although orthopedic surgery may sometimes present different and somewhat less difficult problems for the operator, nevertheless it too has its particular pitfalls. For instance, the difficulty in making a differential diagnosis between acute osteomyelitis in its initial stages and acute rheumatism; or the ease with which the surgeon may fail to recognize fractures, or the onset of ischemic contracture.

Genitourinary Surgery. It need not be necessary to remind our readers that this specialty requires careful preoperative preparation, including radiography, cystoscopy, urinalysis, blood tests, etc., for correct diagnosis is imperative to success.

In this connection may we refer to a recent most encouraging and growing tendency on the part of progressive obstetricians to adapt the methods of surgery, especially in its efforts to combat sporadic postoperative sepsis of intrinsic origin. In an article published in the *British Medical*

Journal, Dr. Victor Bonney, gynecological and obstetrical surgeon to Middlesex Hospital, comments upon this change, and outlines these methods of surgery which apply especially to the practice of gynecology and obstetrics. They are, he writes, "the sterilization, or, if sterilization be impossible, the exclusion from the field of action, of the approaches to the operation area; the avoidance of unnecessary trauma and unnecessary hemorrhage in that area; and the removal beforehand of septic foci in other parts of the body." Dr. Bonney adds hopefully that the future will probably increase the number of these methods by the addition of reliable immunization of the patient before operation.

In summary these few suggestions are offered for consideration:

1. Try to anticipate every surgical step, sticking to a true and tried technic, and following through each step with the most careful observation, based upon painstaking contemplation and a scrupulous preliminary consideration of all the aspects and potentialities of the case in hand, the operative results, and the probable prognosis.

2. Let the welfare of the patient be your prime consideration. Be careful not to expose him to serious risks, remembering that the tissues of the human organism are tender and easily injured beyond repair. Do not make exploratory operations for simple surgical procedures, nor extensive excisions, cuts, or other mutilations of tissue, nerve or muscle.

3. Last but not least, never forget that adequate training, suitable temperament, true prowess, physical fitness, the power of vision, much as you may associate them with the precepts of medical college days or your early researches into medical literature, are not at all out worn or out dated by the magnificent advances of modern medical science; but on the contrary have assumed a new and more vital significance than ever held in the olden days. Belief in these qualities as pass-words to success is as old as Hippocrates and as young as the latest winner of the Nobel Prize in Medicine. So cling to them, and cultivate them, for they are the seeds which will develop into that most essential and ennobling characteristic of every great specialist in surgery, the surgical conscience.

Henry J. Kohlmann.

JAMES TATE MASON

1882–1936

James Tate Mason, of Seattle, President of the American Medical Association, and for many years an active member of the Editorial Board of The American Journal of Surgery, died June twentieth, at the Virginia Mason Hospital.

Doctor Mason led an active and full life. By his originality of thought, dexterity and hard work he became one of the outstanding surgeons of the country and received many deserved honors. His deep sympathy, geniality and capacity for friendship drew many to him.

In his passing the American Journal of Surgery has suffered a real loss, American medicine has lost a leader and a host of individuals have lost a rare friend.

CANCER OF FACE, ESPECIALLY REGION OF EYE

METHOD OF TREATMENT

HOLLIS L. ALBRIGHT, M.D.

BOSTON

CANCER of epidermoid origin in general resolves itself into two types: (1) the acanthoma, with adult squamous cells, varying degrees of hornification and pearl formation, and (2) basal cell carcinoma, the so-called "rodent ulcer." Whereas the latter is rarely seen within the oral cavity, both types frequent arise in the skin of the face. Basal cell cancer has been termed relatively non-malignant[1] mainly because of its tendency to local recurrence and invasion rather than spreading by metastasis. The disturbing nature of this basal cell growth may be seen in the local persistence and progressive ulcerating spread of the lesion over a period of years, especially in the vicinity of the orbit, nasofacial angles and auricle.

Squamous cell cancer, the acanthoma, likewise shows late rather than early spread, but is more rapidly destructive, extends more widely and metastasizes oftener than the basal cell lesion. Except in the case of direct extension of growths primary in the oral, nasal, orbital or aural cavities, to involve the skin of the face, most cancerous lesions of the face will fall into these two groups.

Of the methods employed in eradicating cancer of the skin of the face, excision with or without plastic repair of the defect is the commonest. The initial success of *x*-ray therapy as an agent in the fight against cancer was obtained from its striking destruction of cancer of the skin.[2]

In 1903 Goldberg and London first applied surface radium to 2 cases of basal cell carcinoma of the face with good cosmetic result. At present, adequate *x*-ray and radium treatment have been accepted with surgery as proved methods for the eradication of skin cancer. Preference is held here for none of these three agents to the exclusion of the other two.

It has come strikingly to the author's attention that a practical method of treatment has been evolved which lends itself to fairly universal applicability for skin cancer, especially that of the face. This is perhaps the only region where minimal cosmetic deformity should receive due consideration.

A proved working method of treating malignant skin lesions up to 3 cm. in diameter is presented here, based largely on the experience of the Radiumhemmet, Stockholm,[3] where as is well known, follow-up examinations have been recorded on over 90 per cent of the cancer patients treated since 1915. The method allows effective destruction of the lesion with regeneration of the ectodermal and mesodermal tissue layers at the site of the destroyed growth and preservation of the surrounding normal tissue. By this method an epidermicidal dosage of 7–10 S. E. D. is given, to ensure destruction of the tumor, rather than to employ a dosage of subepidermicidal, selective intensity. A stable scar usually results, with minimal deformity and better cosmetic result.

Lesions up to 3 cm. in diameter, including those of the lip, are implanted with radium element needles, either six needles each of 10 mgm. strength or eight needles each of 3 mgm. strength, using 0.5 mm. platinum filtration. Some therapists employ heavier filtration, but most use at

[1] MACCALLUM, W. G. "A Textbook of Pathology," 4th edition, p. 1034.

[2] Roentgen therapy obtained its first cancer cure when Tor Stenbeck of Stockholm, in 1898 treated a basal cell carcinoma of the nose that had recurred twice after coagulation with the red hot iron. Forrsell followed that patient until 1920. There was no recurrence.

[3] Observed from July to October, 1934, inclusive.

least the equivalent of 0.5 mm. platinum, for this adequately screens the alpha and absorbs approximately 98.5 per cent of the soft beta rays coming from radium C.

TABLE OF FILTERS WHICH EQUAL 0.5 MM. PLATINUM*

	Millimeters
Gold	0.56
Lead	0.97
Silver	1.02
Copper	1.20
Brass	1.26
Steel	1.37
Zinc	1.51
Aluminum	3.96

* Computed from Heversy and Parnth.

One treatment of usually not more than four hours is required. This gives a total dosage of 6 needles × 10 mgm. each × 4 hrs., or 240 milligram hours. This is followed by hyperemia, local swelling, leading to ulceration in ten days, at which time beginning re-epithelialization is evident. By the end of three to four weeks epithelialization should be complete. The end result should be a soft, stable scar, often whitened due to loss of normal epithelial pigmentation. Any persistent induration after six weeks must be strongly suspected as tumor, requiring additional treatment of less intensity.

This general method of treating cancer of the skin of the face, including cancer of the lip (Fig. 1) has been standardly employed at the Radiumhemmet, Stockholm, since 1926. Lesions larger than 3 cm. in diameter have been best controlled by either surface *x*-irradiation (i.e. 7 to 10 S. E. D. via *x*-ray with light filtration of 1–2 mm. aluminum, and careful screening of the surrounding tissues, or via the 5 gm. teleradium bomb at 3 cm. distance, giving a depth dosage of 2 cm.); or by wide excision with pedicle flap repair. The ulceration and necrosis produced by adequate needling of the growth is so extensive as to lead to much sloughing and a less satisfactory result.

To illustrate this method the following case is reported, wherein several problems arising in the management of lesions close to the eye are handled.

Case 1. J. F. M. a rugged, well preserved white male of sixty-nine years was admitted to the Palmer Memorial Hospital on January

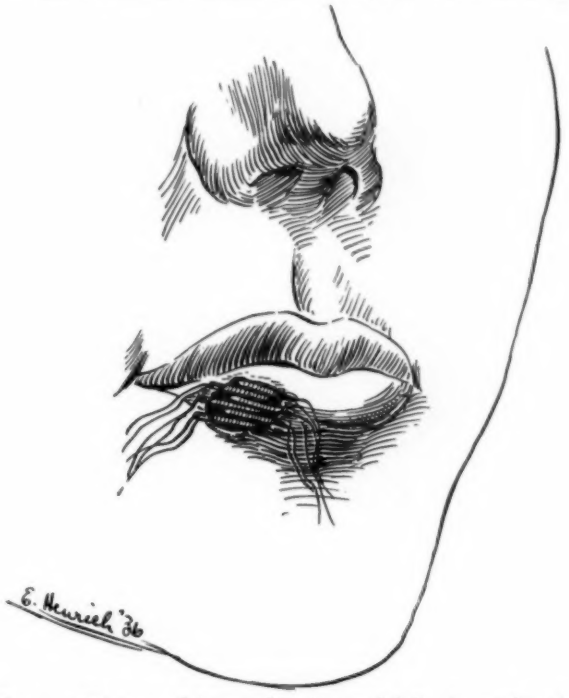

Fig. 1. Cancer of lower lip, interstitially is radiated, showing radium needles in situ.

10, 1936, complaining of a recurring, ulcerated growth in the region of the inner canthus of the left eye, intermittently present for the past twenty years. Seventeen years ago the lesion had been excised but recurred two years later, as large as previously. Fourteen years ago four *x*-ray treatments had been given, with recurrence two years later. Since that time the growth had been cauterized several times, and also had been treated with the electric needle. For the past two weeks the lesion had become ulcerated and had shown increased growth. There had been moderately increased weeping from the left eye.

Examination showed the general physical findings to be negative except for the face. The ulcerated growth at the inner canthus of the left eye measured 1.25 × 0.5 × 0.4 cm. (thick), with a rolled, raised, indurated border, (Fig. 2) extending within 2 mm. of the lower palpebral margin. On the nasal side of the growth there was a healed scar of the previous excision. In addition there were three hyperkeratotic lesions over the face, namely on the right forehead, the left malar cheek and behind the left ear, each measuring from 0.5 to 1.0 cm. in diameter. The blood Hinton was negative.

Radium treatment was begun by applying a surface plaque of 5 mgm. strength and 0.1 mm. platinum filtration to each hyperkera-

Fig. 2. Case J. F. M. showing site of basal cell cancer at inner canthus of left eye.

tosis for six hours, giving a total dosage of 30 mgm. hrs. to each area.

Operation. January 10, 1936, under novocaine infiltration a biopsy was taken from the lesion below the inner canthus of the left eye. This showed basal cell carcinoma. Using the Von Graefe knife (Fig. 3), the long narrow blade of which makes it suitable for preparing the bed for each radium needle, four element needles of 5 mgm. strength each, with 0.25 mm. platinum filtration were inserted directly into the base of the tumor 0.25 cm. apart.

The left eye had been filled with White's ointment and covered with cellophane. Following the insertion of the radium a patterned shield of rubberized lead was anchored by three silk sutures to the skin between the needled area and the lower eyelid and inner canthus so as to protect the eye from irradiation effects (Fig. 4). The needle closest to the eye was removed after five hours and the remaining three needles after six hours. The total dosage was:

5 mgm. × 5 hrs. ::	25 mgmhrs.
15 mgm. × 6 hrs. ::	90 mgmhrs.
	115 mgmhrs.

In three days there was a good radium reaction with hyperemia and beginning ulceration. There was very slight injection of the blood

Fig. 3. Von Graefe knife.

vessels of the bulbar conjunctiva over the inner half of the eyeball. The result at the end of one month showed a soft, pink, smooth scar with no evidence of persistent growth. The small telangiectatic area at the lower angle of the scar was adjudged to be delayed healing because of concentration of the radium dosage at this point. The eye was negative. The slightly increased lacrimation persisted unchanged, and for this reason the nasolacrimal duct was probed as a precautionary measure.

At the end of three months the well healed scar was barely visible. The nasolacrimal duct was demonstrated to be patent by instilling argyrol in the eye and noting its appearance in the left nostril.

In treating malignant skin lesions close to the eye with radium and *x*-ray, several possible pitfalls must be kept in mind.

1. Excision of this growth would have necessitated wide deformity without assurance of a generous margin of surrounding uninvolved tissue, due to encroachment of the lesion upon the lower eyelid.

2. The lens is extremely sensitive to irradiation and must be protected from ready cataract formation. Berven's experience has shown that the lead shield does not always adequately protect the eye and that the distance of the irradiation source from the eye is equally important. In treating lesions of the eyelid silk traction sutures (Fig. 5) may be placed through the lid and strapped to the face with adhesive so as to draw the lid and radium as far from the eyeball as possible during the treatment.

3. Occlusion of the nasolacrimal duct resulting from cicatricial stenosis must be avoided. Increased lacrimation with tears streaming over the cheek is a complication both predisposing to infection and sorely annoying to the patient. The nasolacrimal duct which measures but one-half inch in

length, passes downwards from the medial palpebral ligament, backwards and slightly laterally, to open into the inferior meatus of the nose, under cover of the anterior end of the inferior turbinate. It is slightly contracted at its commencement and termination, and it is in these situations that pathologic strictures of the duct are commonest.

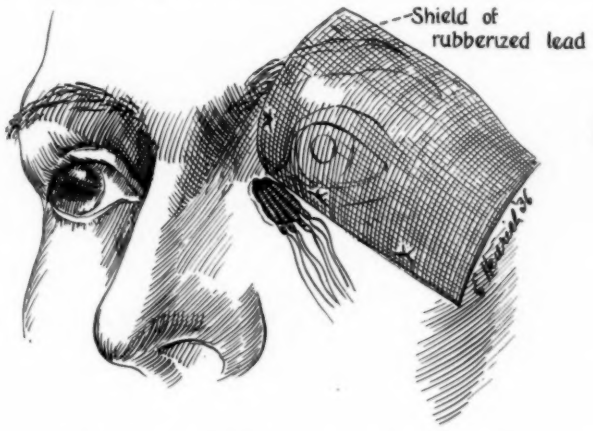

Fig. 4. Method of protecting eye from irradiation effects. The lead shield is anchored to the skin by three sutures of silk.

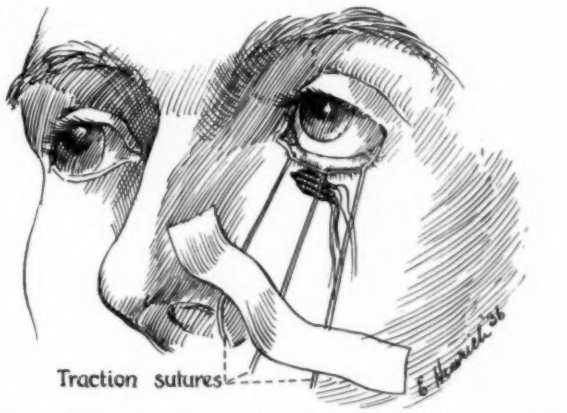

Fig. 5. Method of increasing the distance between the eye and the irradiated lesion.

4. Avoidance of late ectropion formation due to a contracting, dense, fibrotic scar must be considered. It is because of the likelihood of increased bulk and fibrosis in the scar that implantation of more or less permanent radon seeds of 0.3 mm. gold filtration, is perhaps less suitable for lesions of the face.

In the reported case the usual dose of six element needles of 10 mgm. strength each, for four hours, totalling 240 mgmhrs. was diminished to half that amount because of the approximation of the sensitive structures of the eye. Thus four needles each of 5 mgm. strength and reduced filtration of 0.25 mm. platinum, were imbedded for six hours, totalling 115 mgmhrs.

SUMMARY

The treatment of cancer of the skin of the face has been outlined in general. One fairly standard method of using interstitial radium is described in detail, based largely on the method employed during the past ten years at the Radiumhemmet, Stockholm. The method has been illustrated with a case report, in which the management of interstitial radiation methods in the region of the eye has been emphasized.

CONCLUSIONS

1. The acanthoma, with varying degrees of hornification, and the basal cell carcinoma comprise the chief types of cancer of the skin of the face.

2. Surgery, radium and *x*-irradiation have their more or less definite indications according to the size and location of the lesion.

3. For lesions up to 3 cm. in diameter excision, interstitial radium or surface *x*-irradiation may be effectively used.

4. For lesions larger that 3 cm. in diameter excision with plastic repair, or destruction by surface *x*-irradiation are the methods of choice.

5. A controlled method of treatment for cancer of the skin of the face, including cancer of the lip, is presented, based on the experience of the Radiumhemmet, Stockholm.

6. Epidermicidal radium dosage is given, rather than that of subepidermicidal, selective intensity.

7. In radiating lesions close to the eye one must guard against cataract formation, tear duct stenosis, ectropion and corneal ulceration.

SIGNIFICANCE OF GROSS HEMORRHAGE IN PEPTIC ULCER*

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DURING the years of 1934 and 1935 there were 36 cases of gross hemorrhage on the 4th Medical and Surgical Wards of Bellevue Hospital. When we compare these to 87 cases on the same division during the years 1911 to 1933 inclusive one can see that for some unknown reason there has been a marked increase in hemorrhaging ulcers coming under our observation. That gives a total of 123 hemorrhaging ulcers during this twenty-five year period.

There is no uniformity of opinion as to whether a patient with a gross hemorrhage should be treated by absolute rest without transfusions or whether transfusions should be given or lastly whether transfusions followed by operation should be employed. A recent editorial in Surgery, Gynecology and Obstetrics by Walters[3] states: "Studies of the results of various operative procedures for duodenal ulcer have shown that gastroenterostomy alone will protect the patient against recurrence of hemorrhage in 82 per cent of the cases and of equal importance is the fact that, should hemorrhage recur after gastroenterostomy, it is seldom of serious import." Our observations do not offer such a favorable report for gastroenterostomy in bleeding duodenal ulcers.

A consideration of gross hemorrhage in peptic ulcer necessitates a classification of the cases before a clear conception of the method of treatment can be discussed. For that reason I wish to emphasize the classification[1] which has been previously used in discussing gross hemorrhage in peptic ulcer. The cases are divided into five groups: (1) hemorrhage occurring in patients with peptic ulcer under competent medical management; (2) hemorrhage in cases operated for an acute perforation or chronic ulcer, that has never bled until months or years following operation; (3) hemorrhage occurring in ulcers that had been operated previously for hemorrhage and the patient has continued to have recurring postoperative hemorrhage; (4) severe hemorrhage that has occurred in patients with negative, or very short gastric histories, and the patient never knew that he had an ulcer until the hemorrhage occurred; (5) patients admitted with hemorrhage and a long history of ulcer symptomatology but without regulated medical treatment.

When the cases falling in the different groups are considered one can see some justification for such a clinical grouping. In Group I the 20 cases or 16 per cent of the total gross hemorrhages occurring that we encountered, were in 577 unoperated ulcers that were under observation in the clinic. This would give an incidence of only 3.3 per cent hemorrhage in ulcer cases under competent medical care. In view of this small percentage of hemorrhage in patients that were receiving medical treatment one should not become unduly alarmed over such a complication. As these patients had been carried on a medical regime one does not seem justified in continuing medical treatment in this particular group as one should be aware of the posterior duodenal ulcer that may erode through the pancreaticoduodenal artery with a fatality.

Group II is of considerable importance as one is frequently undecided whether to reoperate upon these patients or treat them conservatively with medications and a dietary regime. We have encountered 14 cases or 12 per cent of our bleeding ulcers in this group. In considering the group of cases it is well to recall the

* From the 4th Medical and Surgical Divisions of Bellevue Hospital, Drs. Charles H. Nammack and Carl G. Burdick, Directors. Read before the American Therapeutic Society, Kansas City, Mo., May 9, 1936.

editorial previously referred to in which it was stated that serious hemorrhage seldom follows a gastroenterostomy. As a gastroenterostomy in this group of cases had been done for chronic ulcers that had never hemorrhaged previous to their operation, but despite the gastroenterostomy, hemorrhaged several months or years later. It is important to emphasize that the hemorrhage apparently was from the original lesion as in none of these cases was a marginal ulcer demonstrated. We have been very conservative in this group and do not recommend reoperating unless the patients have had two or more severe hemorrhages.

Group III is very disconcerting as the patients that we have encountered in this group, number 6 or 5 per cent of the total number. Although they had been operated for gross hemorrhage they have continued to hemorrhage and one is confronted with extremely difficult cases to handle. If no evidence of a marginal ulcer is demonstrated, then one should continue conservative treatment until the patient had had at least two severe gross hemorrhages. The following case will emphasize this group.

Male, aged fifty-seven years, admitted January 23, 1924, with a history of bleeding from the rectum for ten days, and vomiting blood. He states that six years previously he had a similar attack, and a second attack four years ago, but between the hemorrhages he has no abdominal pain or discomfort. During the first two seizures he was treated at home for several weeks. On January 25, 1924, he was transfused receiving 600 c.c. of blood by the direct method and made an uninterrupted convalescence. A roentgen-ray series on February 20, 1924, revealed a duodenal ulcer. He was discharged February 21, 1924 and readmitted February 28, 1924, because of bleeding from the rectum for two days. March 6, 1924, a gastroenterostomy was done for a duodenal ulcer. He was discharged March 26, 1924. He was readmitted September 5, 1926, with a history of having been perfectly well until four days before admission when he passed tarry stools and vomited blood. He was transfused by the direct method on September 7 receiving 400 c.c. blood. *X*-ray films taken September 20, 1926, revealed the stoma to be normal and the patient was discharged September 24, 1926, symptom free. He was readmitted August 18, 1927, stating that he had been well since his last discharge until the day of admission when he passed tarry stools and vomited blood. Gastrointestinal series done September 30 revealed a normal gastroenterostomy stoma with a duodenal deformity. The patient was reoperated September 16, 1927, and an exploratory laparotomy revealed a normal gastroenterostomy stoma with a duodenal ulcer but nothing further was done and the abdomen was closed in anatomic layers. Since leaving the hospital this patient has been followed regularly in the clinic, reporting every month for the past eight years, and during this period he was well until September 1933, when he was readmitted with a severe hemorrhage which necessitated two transfusions of 500 c.c. each. He had another severe hemorrhage in July, 1934 which required hospitalization and a transfusion and he remained in the hospital for three weeks. Roentgenograms taken January 4, 1929, revealed a normal stoma, otherwise negative. Again on May 5, 1930, *x*-ray pictures were negative, and also on July 10, 1932. *X*-ray studies taken November, 1933, and July, 1935 revealed some deformity of the duodenum but a normal stoma.

COMMENT

One can see from this case report that it is difficult to draw any conclusion from a bleeding ulcer until a number of years have elapsed. It is seen that this patient went for a period of six years following his second operation which was merely an exploratory laparotomy for a bleeding duodenal ulcer. A normal gastroenterostomy stoma was found and the original duodenal ulcer was still present but no operative procedure was done on the ulcer and the abdomen was closed. This patient returns regularly every four weeks and at no time has he ever had any abdominal pain.

In Group IV we are confronted with the problem of conservative treatment or surgical intervention. In reviewing the 22 cases, or 18 per cent of the total number,

we find that 11 died during conservative treatment. Of these 11 cases 7 had one or more transfusions, most of them several transfusions and 5 patients had merely sedatives and other supportive measures, but they resulted in a fatality. We question whether any of this group could have been saved by operative intervention as they were in an extreme condition and some died so suddenly after the onset of the hemorrhage it would have been impossible to operate upon them. Of the cases that recovered we have employed medical management with gratifying results. The blood urea determination as advocated by Ingegno[2] may be of some value in this group. He feels that an increasing rise of the blood urea points to an ulcer that continues to bleed. The prognosis is unfavorable and radical intervention may be indicated. One should remember that the patients in this group are rarely seen except in hospitals with an active ambulance service as they have had no previous gastric symptomatology and suddenly collapse from the hemorrhage.

In Group V one sees by far the largest number of cases that we encountered. In this group 61 cases or 49 per cent of the entire group were patients that had symptoms over a number of years and a large percentage of them having had a positive diagnosis of ulcer, but have been uncooperative and have refused a systematic medical management. These cases stress the importance of a patient suffering from a peptic ulcer remaining under competent medical management otherwise they run a risk of a severe gross hemorrhage. These patients have been treated by transfusions and conservative measures and allowed to be discharged to the clinic, but in spite of this severe complication which they have encountered, they frequently will not continue under medical treatment after the first few weeks or months. For that reason, 14 of the 61 cases have been readmitted. As a high percentage failed to remain under treatment in the clinic we feel that a large number have been admitted to some other hospital for recurrent hemorrhage as 50 per cent of our gross hemorrhages fall in this group. Whether an operation is indicated in these conservatively treated patients is questionable. The advice for each patient has to be individualized and if one feels that the patient will cooperate after his condition has been explained to him then medical treatment unquestionably is indicated and justifiable, but if one has an uncooperative individual as the majority of this group are, then an operation should be considered and advised when the patient's condition warrants it.

SUMMARY

The only conclusion that we can draw from these observations is that one must individualize the treatment for each hemorrhaging ulcer that is encountered. The following points should be stressed: (1) that patients may die from hemorrhage under conservative management regardless of whether they are transfused or not; (2) if the patient is operated we feel that it is essential to remove the ulcer or ulcers and this can best be accomplished by a subtotal resection; (3) hemorrhage does occur frequently following gastroenterostomy and the hemorrhage apparently comes from the original ulcer and not from a marginal ulcer, although this occassionally does happen. A negative roentgen study does not exclude a marginal ulcer, but, if the patient is free from pain plus a negative roentgenogram then one is fairly certain that a marginal ulcer does not exist. There were 12 cases that bled after gastroenterostomy for chronic ulcers and 4 that had recurring hemorrhage after gastroenterostomy for bleeding ulcers. In other words, of the 123 bleeding ulcers, 16 or 13 per cent, had had gastroenterostomies performed but have had severe hemorrhage following the gastroenterostomy.

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INTRAVENOUS USE OF PITOCIN*

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SINCE its introduction to the medical profession as an oxytoxic agent, pituitary extract has undergone several modifications, in dosage, method of administration and preparation. The product when first marketed commercially was quite strong and there were many accidents following its wide use. The manufacturers then began marketing a weaker product and in smaller ampoules, the result being fewer accidents, but a product which appeared quite unstable in its action, in some cases the results being quite satisfactory and in others either entirely absent or very poor. This was soon corrected and the product is now quite stable clinically. The next forward step in the preparation was to separate the pressor and the oxytoxic principles of the posterior pituitary lobe and to market them individually under trade names of pitressin and pitocin. The latter is intended for obstetrical use only and can apparently be given with safety to the hypertensive parturient woman, there being no further increase in her blood pressure following its administration.

Originally intended to be given intramuscularly, it was next injected directly into the uterus at cesarean section, the results here being variable, but mainly satisfactory. Several years after its introduction to the profession, it was suggested that a satisfactory result could be obtained by bringing the pituitary extract into contact with the nasal mucosa and this method of administration began to enjoy a moderate popularity which still continues.

In recent years there began to appear in the literature articles about the administration of pituitrin intravenously and at the present time results on its use in this manner have been published by Zorn,[8] Fuchs,[6] Heffernan,[7] Alden,[1] Bohler and Reiles,[3] Barron,[2] and Debiasi and Romussi.[4] Space does not permit an abstract of all of these articles, but it will suffice to say that these authors were in accord that given intravenously pituitary extract is a powerful oxytoxic agent, causing prompt and vigorous uterine contractions, the maximum effect being obtained in a few seconds and continuing for six to thirty minutes. Some advocate its use only after completion of the third stage, while others have given it during labor and even to inaugurate this process. The antepartum dosage varies between 0.05 c.c. to 0.15 c.c., while much more liberal doses may be given postpartum; it is contraindicated in cardiac and renal disease, eclampsia and before delivery in cases of previous section, disproportion or cervical amputation, a list which would be equally true were we speaking of any other method of administration. DeLee[5] injects a word of caution and states that he has seen several cases of "pituitary shock" following intravenous injection. He does not mention the dosage used in these cases, but since others have not reported these unfortunate results, it is possible that they were fairly large, since in our clinic with moderate doses no "pituitary shock" in any degree has been noted.

After attention had been called to this method of administration, it was decided to try it in a series of selected cases. Pitocin was chosen since it is practically standard in the clinic and since only oxytoxic action was desired; and was used exclusively in

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this series. It was used only postpartum, the authors being convinced that it is a most unsafe procedure to employ it prior to or during labor. The usual dose given was 0.15 c.c. although in extreme cases as much as one ampoule (0.5 c.c.) has been given. When prolonged action was desired the dose was repeated, but never in less than one-half hour. It has now been given to 62 patients, for the following indications:

Atony of the uterus	56
History of previous postpartum hemorrhage	3
Delayed postpartum hemorrhage 5 or more days postpartum	3
Delivery in these cases was:	
Normal	6
Operative	56
Cesarean section	37
Classical	23
Laparotrachelotomy	14
Forceps	15
Version and extraction	4
Results:	
Excellent	58
Fair	2
None	2

The method of administration was usually by the routine venapuncture, but upon several occasions, when the patient was already receiving glucose solution intravenously, the drug has been given by injecting it into the rubber tube which was attached to the venapuncture needle. This is quite simple, apparently as efficacious as when a direct entrance of the vein is employed, and saves one venapuncture, possibly preserving the vein for future use if more fluid is needed. On the other hand we have never seen damage to the vein or other local irritation.

The first of the two failures was in a patient delivered by classical cesarean section for premature separation of the placenta. Following delivery of the baby the uterus failed to contract and refused to respond to this or any other form of stimulation and finally the operator felt compelled to remove it. The muscular walls of the uterus, in this case were massively infiltrated with blood which prevented the concerted action of the drug. The second was an intensely interesting case of a multipara who had had a slight amount of bleeding in the last week of her pregnancy and therefore was admitted to the hospital at full term and in active labor. She was not bleeding on admission and did not bleed again prior to delivery which occurred spontaneously a short time after entering the hospital and without the use of any oxytoxics. The baby was stillborn and with its birth there was expelled from the uterus a large number of very dark blood clots together with some fresh blood. Spontaneous delivery of the placenta occurred immediately after the birth of the child and it exhibited a large area of premature separation. The patient, who prior to delivery was in good condition, suddenly gave evidence of profound shock. The uterus was found to be atonic and could not be made to contract in spite of the intravenous pitocin and other methods and in a short while the patient was dead. At autopsy a large rent in the lower uterine segment with hematoma formation in the broad ligament of about 500 c.c., was demonstrated. The muscle layers of the uterus were markedly engorged with blood and, as in the previous case, disrupted with hemorrhage. The reason for failure was quite evident.

The results generally have been excellent, the uterus contracting vigorously in a few seconds, 2 to 3, and remaining firm for approximately one-half hour. It is this sustained contraction which has led us to believe that its use should always be restricted until the completion of the third stage. When given following cesarean section where the abdomen is open and the uterus may be observed, the reaction is exceedingly interesting. In several instances the contraction was so pronounced that the organ became decidedly blanched, the blood being forced out by the vigor of the contraction. In 2 cases the results are reported as being only fair; both of these were classical cesarean sections in which the uterus had been lifted from the abdomen for suturing. The response to the drug was mediocre in these two instances, but neither required a second dose, and on

both occasions when the organ was replaced and tension relieved, it contracted well and both patients made an uneventful recovery. It is felt that neither of these should be classed as failures of the drug.

CONTRA-INDICATIONS

These do not seem to exist, and any patient who has been delivered and appears to need pitocin for its oxytoxic effect may apparently be given the drug intravenously in doses of 0.15 c.c. or in greater emergencies 0.25 c.c. to 0.5 c.c. with safety. There does not appear to be any pressor activity associated with this drug so that it is apparently not contraindicated in toxemic patients, those with cardiovascular conditions, damaged kidneys, etc., etc. It should again be emphasized, however, that the authors do not recommend its use prior to the completion of the third stage considering the uterine response to be too rapid and too vigorous.

CONCLUSIONS

1. The intravenous administration of pitocin produces efficient uterine contractions within a few seconds of its administration.

2. The contraction persists for about thirty minutes.

3. The contraction is so vigorous and sustained that the drug should not be given prior to the completion of the third stage.

4. The apparent absence of the pressor factor in this particular preparation permits of its use in almost all cases.

5. A dose of 0.15 c.c. is usually sufficient, but 0.5 c.c. may be given apparently without ill effects.

6. If repetition is necessary, which is rare, the second dose may be given thirty minutes after the first.

7. No instance of so-called "pituitary shock" has been observed in our series of cases.

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CLOSED REDUCTION OF REVERSED COLLES' FRACTURES

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THE statements of Webb and Sheinfeld[1] which were published a few months ago have aroused a great deal of controversy regarding the treatment of reversed Colles' fractures.

These fractures are not very common, but if all the available cases could be collected the methods of treatment would be more accurately evaluated. The more recent papers of Gaynor,[2] Raymer[3] and Bettman[4] have already thrown further light on the general management of this injury.

Since this fracture occurs infrequently, and since Webb and Sheinfeld[1] have stated that "no cases of successful reduction by the closed method have been reported in the literature," they have concluded that the fracture must therefore be considered irreducible and open operative reduction indicated.

We wish to report the following additional cases which were successfully treated by closed manipulation.

CASE I. Mrs. F. D., aged thirty-seven years, slipped and fell on the ice on November 17, 1933, with her left wrist in a flexed position and that the posterior aspect was struck against the ground, immediately developing pain and deformity in the region of this joint. At the Evanston Hospital *x*-ray films revealed a typical reversed Colles' fracture with marked ventral displacement of the lower end of the radius. It was noted that the patient had a congenital absence of the styloid process of the ulna. The distal fragment of the radius showed considerable comminution, but chiefly in large pieces.*

Under 2 per cent novocain anesthesia injected into the hematoma the fracture was reduced easily by first hyperflexing the wrist joint to break the impaction, and then by traction, dorsal extension and moderate ulnar deviation. Anterior and posterior molded plaster of paris splints were then applied, still holding the wrist joint in moderate extension and ulnar deviation. Postreduction roentgenograms showed an excellent position of the fragments.

The cast was inspected frequently but was not removed until one week after the injury, when the wrist joint was moved passively while the fragments remained in good position. The anterior half of the cast was then reband-aged in place. Gentle physiotherapy was started on November 29, 1933, and on December 5, 1933 the cast was removed and a straight board splint was applied. Passive motion in the wrist joint was still very good. The splint was removed entirely and left off twenty-six days after the injury. The patient was advised to use her wrist as much as possible providing too much strain was not exerted. She was seen one month later, approximately two months after the injury, and at that time flexion and extension were found to be nearly perfect. Very little swelling remained and there was no tenderness whatsoever. One year later when seen again there was no apparent difference between the wrists.

CASE II. Mrs. J. G., aged seventy years, was seen April 18, 1935, within an hour after she had fallen from a stool, striking the dorsal aspect of her right wrist at a time during which it was held in flexion. *X*-ray films taken at the Evanston Hospital showed an oblique fracture through the lower end of the right radius with the distal fragments displaced ventrally and impacted into the upper end of the radius. There was approximately ¾ inch shortening of the bone. There was also a fracture of the styloid process of the ulna and a posterior dislocation of the ulna in its joint with the carpus. (Figs. 1 and 2.)

A 2 per cent novocain solution was injected into the hematoma and after anaesthesia was complete the impaction was broken by hyperflexion at the wrist joint. Traction was then applied and the fragments manipulated and the wrist placed in a position of semi-extension and ulnar deviation. Anterior and posterior molded plaster-of-paris splints were then applied

* Unfortunately these films cannot be located so that illustration is impossible.

extending from the base of the fingers to the elbow joint, still maintaining the position.

X-ray films taken immediately showed the position to be unsatisfactory although improved. The plaster-of-Paris splints were removed and the fracture again manipulated under the fluoroscope. On the second attempt at reduction the same manouvers were used except that the wrist joint was put in extreme extension and ulnar deviation. It was seen under the fluoroscope that a satisfactory reduction could be obtained in this position. Consequently the parts were again immobilized in fresh molded plaster-of-Paris splints with the hand held in extreme extension and ulnar deviation.

After this second reduction the fragments were in satisfactory position although there was still nearly ½ inch of shortening in the radius due to impaction of the fragments. The ulna was found to be replaced in its normal relationship with the carpus. (Figs. 3 and 4.)

This patient was kept in the hospital for three days until the hazard of swelling was past. The cast was removed eleven days after the injury, when the arm was washed, massaged and the wrist joint moved passively. Only the anterior half of the cast was reapplied. Beginning sixteen days after the injury, the anterior splint was removed twice daily for hot soakings, massage and passive motion. Three weeks after the injury a straight board splint was applied which was removed for two or three hours every evening and the wrist hung over the edge of a chair to gradually increase the amount of flexion by the aid of gravity.

The splint was left off entirely after four weeks from the time of injury. She still complained of pain and a prominence over the region of the ulnar styloid, attributed to the local injury and aggravated by the shortening in the radius, which threw the distal end of the ulna into a more prominent position. Physiotherapy was continued for several weeks after the removal of the splint with gradual improvement of her symptoms. She was last examined in October, 1935, six months after the injury; there was no pain in any area of her wrist

Fig. 1. Fig. 2.

Case II.

joint, about 80 per cent extension and 70 per cent flexion, adduction and abduction being normal. There is still a slight deformity due to the lateral projection of the distal end of the ulna but it is no longer painful. The patient does everything without discomfort.

Fig. 3.

Fig. 4.

Case II.

Although the result on the second patient is not as good as the first, the injury was much more complicated, and for the pathology described originally her functional result is very good. If the patient were not an elderly woman and if she still complained of pain over the ulnar styloid one might consider resection of the lower end of the ulna, as advocated by Darrach. In any event, we do not feel that had this patient been treated by immediate open reduction the final result would have been any better.

Case III. Mrs. E. J. M., aged forty-two years, fell on the back of her right wrist on March 22, 1934. She "felt a crack" and immediate pain in the wrist. Examination showed the distal part of the wrist with the hand displaced anteriorly (to the palmar side) giving a reversed silver fork deformity. *X*-ray films (Fig. 5) showed a complete fracture of the distal end of the radius, with anterior (palmar) and radial displacement of the distal fragment, together with a complete fracture of the styloid process of the ulna with radial displacement.

Under nitrous oxide anesthesia the fracture was reduced under the fluoroscope and a plaster cast applied. *X*-ray films showed good approximation of the fragments but there was still a small piece displaced anteriorly. Upon second attempt a better approximation was obtained. (Fig. 6.) Case reported, "The position of the fragments is as satisfactory as can be obtained under the circumstances. The fragment of the radius is displaced downward more than one would like to see it, but after several attempts at reposition of the fragments,

Fig. 5A. Fig. 5B.

Fig. 5. Case III.

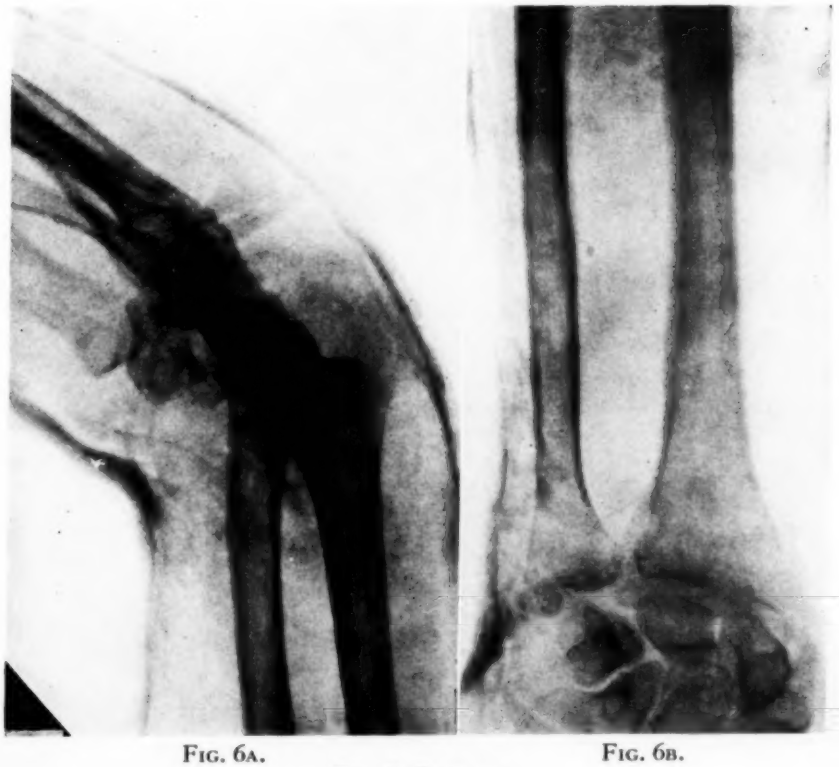

Fig. 6A. Fig. 6B.

Fig. 6. Case III.

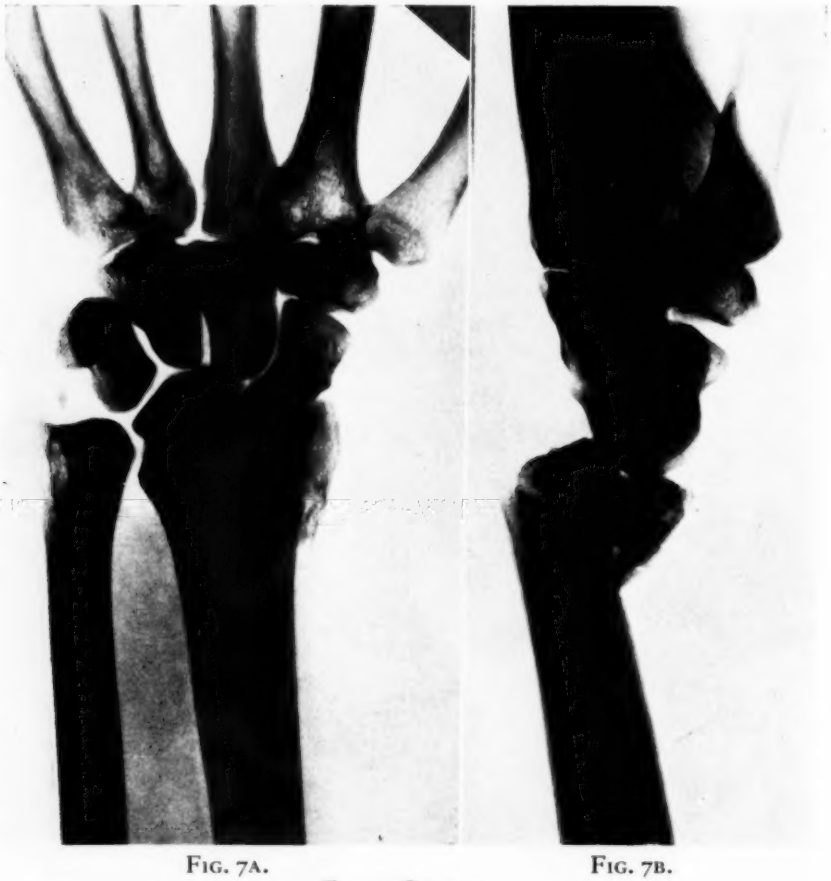

FIG. 7A. FIG. 7B.

FIG. 7. CASE IV.

FIG. 8A. FIG. 8B.

FIG. 8. CASE IV.

I think this can be accepted as satisfactory under the circumstances." The hand was placed in dorsal extension and ulnar deviation and fixed in a plaster cast extending from the fingers to above the elbow. The next day the cast was split lengthwise along the ulnar side to relieve pressure.

April 4, 1934, upon readjusting the cast motion was present in the wrist, fingers and hand, and the position was good.

April 7, 1934, the elbow part of the cast was removed. Motion gradually improved, stiffness disappeared and pain was absent. She was seen twice weekly for manipulations and massage.

The patient was last seen on June 29, 1935, when all motion was present except extension which was about 85°, while it was about 95° in the left hand. Pain was absent and the wrist was strong and 100 per cent useful. The ulnar styloid, however, was still slightly more prominent and there was a slight hollow distally.

Case IV. Wm. W., aged sixteen years, on July 3, 1935, was "cut off" while riding a bicycle and fell holding onto the handlebar, injuring the right wrist. The hand was swollen, not very tender and displaced forward at the wrist, presenting a reversed silver fork deformity. *X*-ray films at the Evanston Hospital reported by Crowder showed, "A reverse Colles' fracture of the right wrist, about one inch from the distal extremity of the bone. There is a forward displacement and angulation of the small distal fragment. Also there is a fracture of the styloid process of the ulna." (Fig. 7.)

Under nitrous oxide anesthesia, using the fluoroscope, a satisfactory reduction was obtained, the hand in slight dorsiflexion, so that all motion was freely present in the fingers and hand. Subsequent films showed, "After reduction we find that the deformity has been reduced somewhat, but there is still a rather sharp anterior angulation at the point of fracture." (Fig. 8.) July 4, 1935, the cast was split and eight days later removed and readjusted.

July 20, 1935, all motion was present and comfortable, and six days later active motion was commenced.

When last seen September 14, 1935, the wrist was normal and all motion present.

Note: In Cases II, III, and IV, although the reductions were not anatomically perfect on the palmar side, they showed good alinement on the dorsal side and entirely useful, painless wrists were obtained with practically complete free motion.

SUMMARY

1. Four further cases of successful reduction of reverse Colles' fracture by closed manipulation are herein described.

2. Although it may be impossible to get a perfect anatomical reduction in reverse Colles' fractures in some cases, nevertheless perfect painless function may be obtained, thus obviating the necessity of open reduction. In this particular, these cases differ from the usual Colles' fractures, where perfect anatomical reduction is desirable.

3. We feel that the same indications for open or closed reduction are present in the treatment of a reversed Colles' fracture as are advisable in any other type of fracture. Furthermore, we believe that the closed method should always be given preference.

4. Finally, a word of caution should be added as these cases may be among the most difficult type of fractures to treat successfully.

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USE OF UREA TO STIMULATE HEALING IN CHRONIC PURULENT WOUNDS*

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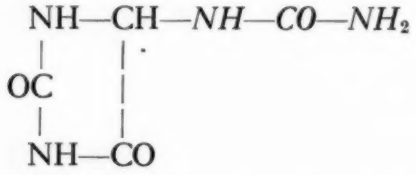
IN an investigation of the means by which the healing effects of surgical maggots are produced in suppurating wounds of long standing, it was recently discovered that the purine derivative allantoin, $C_4H_6N_4O_3$, occurs in maggot excretions and stimulates healing in purulent wounds.[6] Further study has shown that this is not the only substance with therapeutic properties present in maggot excretions. The still simpler and well known product of protein metabolism, urea, $CO(NH_2)_2$, has been found to produce similar healing effects.

Interest was aroused in the possibility that urea might have healing characteristics through the picture presented by the structural chemical formula of allantoin, namely:



Upon hydrolysis, the side chain which is shown in italics easily forms urea, $NH_2—CO—NH_2$. The conception that allantoin is therapeutically active partly through its side chain has been only suggestive and merely led to the present investigation. Urea is, of course, normally present in human tissues and it is administered also intravenously and subcutaneously without harm to experimental animals.

In order to proceed with this investigation the interest of a number of physicians and surgeons was obtained and initial treatments were made. Sterile urea solution was supplied by the Bureau of Entomology and Plant Quarantine and work was begun in April, 1935. The results of those preliminary tests proved to be encouraging and the scope of the work was considerably broadened.*

The medical cooperation and clinical facilities thus provided were of course an essential part of the investigation, for without them this study would not have been possible. The methods of preparing and applying the treatment are described later.

A considerable range of purulent conditions have been treated, such as varicose and diabetic ulcers, carbuncles, suppurating *x*-ray burns of long duration, extensive infected heat burns, intraoral infections, osteomyelitis and certain skin infections. From the results obtained, the urea treatment can be stated to produce, in general, a conspicuous cleansing of the wound, with a lessening of the foul odor through the removal of necrotic material; a reduction in the pyogenic infection; and a rapid development of granulation tissue. The response of suppurating lesions to the

*The writer is indebted to the following cooperators, who have tested the effectiveness of the urea treatment: Dr. J. F. Armentrout, 209 Medical Arts Bldg., Roanoke, Va.; Dr. A. K. Baldwin, Carrollton, Ill.; Dr. Joseph J. Bateman, 3010 Wisconsin Ave., Washington, D. C.; Dr. Arthur Berke, New Rochelle Hospital, New Rochelle, N. Y.; Dr. R. J. Bennett, 10960 84th St., Edmonton, Alberta, Canada; Dr. John S. Dorian, 142 Joralemon St., Brooklyn, N. Y.; Dr. A. K. Germann, 1231 Maine St., Quincy, Ill., Dr. A. H. Gross, Suburban General Hospital, Bellevue, Pa.; Dr. H. H. Hookway, 10 High St., Boston, Mass.; Mr. Arthur Joseph, Superintendent, Bliss Electrical School, Takoma Park, Md.; Dr. C. C. Joyner, Farmville, N. C.; Drs. Kohl and Griggs, Leverenz Bldg., Sumner, Wash.; Dr. J. J. Kvatsak, Suburban General Hospital, Bellevue Station, Pittsburgh, Pa.; Dr. G. S. Llewelyn, Pittsburgh City Home & Hospitals, Mayview, Pa.; Dr. Stephen Maddock, Boston City Hospital, Boston, Mass.; Dr. R. H. Mitchell, Children's Hospital, Washington, D. C.; Dr. N. C. Ochsenhirt, Jenkins Arcade, Pittsburgh, Pa.; Dr. J. M. Peña, Hospital Nuestra Señora de las Mercedes, Havana, Cuba; Dr. J. B. Quicksall, 221 Taylor Arcade, St. Petersburg, Fla.; Dr. W. P. Sherlock, Veterans' Administration, Des Moines, Iowa; Dr. A. H. Weinstein, 8502 Ft. Hamilton Parkway, Brooklyn, N. Y.; and Dr. A. F. Yerg, Warren General Hospital, Warren, Pa.

* Contribution from the Division of Insects Affecting Man and Animals, Bureau of Entomology and Plant Quarantine, U. S. Department of Agriculture.

urea treatment can sometimes be observed after two or three days' treatment, when cleansing of the wound with healing appears to be already started. As healing progresses, indolent tissues become pink or red and begin to fill the wound. The increased blood supply to the part is evident in the hyperemic color and the tendency of the wound to bleed readily. The use of a sedative, which had been given previous to the urea treatment, became unnecessary in some cases, pain being relieved during the treatment.

The present paper is an attempt to bring to the attention of those who have cases of chronic external suppurating wounds the use of this simple, harmless, and effective treatment. A few typical case histories, supplied by the medical cooperators, are included. Owing to the wide range of purulent conditions treated, a number of reports on each would extend the paper considerably beyond its present scope. Conviction as to the merits of the urea treatment will be more readily obtained by actual trial.

Case I. S. A., female, aged twenty-four years, had chronic osteomyelitis of the right femur for three years with failure to heal and a fistula developed. This discharging sinus closed at intervals only to reopen with renewed suppuration. On January 15, 1936, treatments with urea were begun. The sinus was irrigated several times daily with the solution. Within one week the fetid odor ceased and the discharge was considerably reduced. The sinus began to close and in six weeks healing was complete. *X*-ray films which previously showed small fragments of sequestra now show no evidence of osteomyelitis. To date the wound has remained healed.

Case II. A white married woman fifty-five years old, had varicose veins for twenty-five years. About eighteen years ago she underwent a surgical operation with partial relief for a few years. Following one or two falls she developed bruises then congestion and subsequent infection with much suffering. In February, 1936, the patient was treated with 2 per cent urea solution, the gauze dressings being kept moist. This afforded instant relief from pain with complete healing in five or six weeks. Recent reports indicate no recurrence.

Case III. S. F. L., female, aged fifty-six years, who two years ago had a ligation of the upper two-thirds of the right leg. On March 4, 1936, the patient was found to have marked swelling of the lower third in the ankle and foot area, with considerable inflammation and pain but no suppuration. She was unable to walk except with great difficulty and pain. This had been her condition for the previous year and it had failed to respond to any treatment. On March 4 moist dressings of urea were applied to the leg daily. Within one week the pain ceased and the swelling began to subside. In a month the swelling was gone and the leg appeared normal. The patient could walk without discomfort. Up to the present, three months later, the leg still appears normal.

Case IV. H. T., aged thirty-eight years, male, presented a diabetic ulcer of left foot, 5 cm. in diameter and 1.5 cm. deep. The ulcer had been refractory to every type of treatment. In June, 1935, urea treatment was given and in four weeks the ulcer was reduced to half its size. Two months later it was entirely healed and has remained healed to date.

Case V. O. W., aged nineteen years, male. On February 22, 1936, the toes of both feet were markedly inflamed, with purulent and watery discharge; considerable pain for the past week and unable to walk in shoes. The right foot was soaked for a half hour three times daily with a 2 per cent urea solution and the left foot was used as a control. In two days pain and discharge of the right foot subsided, the untreated left foot was growing worse. In one week the discharge ceased in the treated foot and the toes appeared healthy and pinkish. Treatment was continued for an additional week when the foot appeared healed; but no improvement was apparent in the untreated foot which is now lame. Began to treat the second foot, which healed similarly in two weeks. There are no indications of recurrence.

Case VI. In postoperative inguinal hernia wounds in obese individuals where so-called "stitch abscess" develops and there is a low resistance of the tissues, a 2 per cent urea solution placed deeply, markedly expedited the formation of firm granulations. In a postoperative abscess located deep in the gluteal folds and fat pad, the urea solution was injected deeply and early with gratifying results.

Case VII. S. A., female, aged sixty years, colored, had varicose ulcers 3 inches wide

extending about two-thirds around the distal third of the leg. The case had been treated elsewhere with various forms of medication without success. Wet urea packs produced rapid healing and the area gradually became epithelialized.

Case viii. C. R., female, aged thirty-six years, was first seen January 29, 1936, because of a digital abscess on the left index finger since July, 1935. Incision and conservative treatment elsewhere with the conventional variety of mild antiseptics were followed without healing. In January the distal half of the finger had foul-smelling sloughs. *X*-ray plate showed no osteomyelitis. After two weeks of treatment with Dakin's solution and dichloramine-T, the distal half of the finger was excised and these solutions continued, but sloughs and foul smell persisted. Wet urea packs were then used. Within one week, the sloughs and foul odor ceased and within three weeks the wound was entirely healed.

Case ix. W. P., male, had a left nephrectomy on January 18, 1936, being discharged from the hospital February 2. Following this the whole incision broke down with draining. Attempts to stimulate granulation were without success for the next two weeks. The wound was covered with greenish-gray scum and discharged freely. On April 1 wet urea dressings were begun and in the next two weeks a most spectacular healing was produced, the wound closing in about 50 per cent in that time. The wound became clean with healthy granulations continuing to develop.

Case x. C. H., aged forty years, male laborer, had an amputation of the index finger for crushing injury. The wound later broke down with purulent discharge and cellulitis of the hand and arm for some time. Wet urea dressings caused cessation of discharge in forty-eight hours and was followed by rapid clearing of the condition with closure of the wound by granulation.

Case xi. B. H., aged forty-six years, female, had radium and *x*-ray treatment in unknown quantities for a carcinoma of the cervix. A hysterectomy was followed by recurrence in the vaginal vault with sloughing and very foul odor. Tampons of urea solution caused separation of the necrotic areas, with marked diminution of odor and pain.

Case xii. Miss B., aged twenty years, had a tooth extracted December 7, 1935. Pain developed the next day and the socket was treated unsuccessfully. One week later we examined case, finding a typical dry socket. A radiograph showed no debris or bone spicules. The socket was irrigated first with urea soluinto then packed with urea dressings. The pain decreased within a few minutes. The patient reported next day with great relief of the pain. The urea treatment was repeated daily. In two days the socket appeared healthy and recovery was uneventful.

Case xiii. C. G., aged fourteen months, boy, had a second degree burn over back and buttocks from boiling water. Tannic acid treatment was applied with some healing, but secondary infection occurred in two weeks which increased in extent. At this time wet urea dressings were substituted. Within two days the wound became clean and healing well advanced. The child was discharged one week later entirely healed.

Case xiv. A. L., male, carpenter, aged fifty-three years, had gangrene and an ulcer of the left fifth toe resulting from exposure to 40° below zero. For three months he had used home remedies without avail. The toe was extremely painful. On admission to the hospital continuous dry heat was applied for six days without improvement. Urea solution was then substituted. In five days the entire blackened region had changed to several red areas, the ulcer had healed, the pain was reduced markedly and the patient was comfortable. Dry heat was again used for four days, the toe healing entirely and the man returned to work.

The occurrence of chronic infections of the urinary system is an apparent anomaly. This, of course, can be maintained by reinfections from various foci. It is known, in addition, that certain pyogenic organisms contain the enzyme urease, which breaks down urea with the liberation of ammonia, thus reducing the effectiveness of the urea content of the urine. In cystitis the urine sometimes has a noticeable odor of ammonia.

Urea is very soluble in water and a solution ready for use is easily prepared. Sterile, distilled cold water was used in preparing the solution used in the present work. It is better not to be heated much above body temperature as a chemical change would take place. Non-sterile water causes a slow breaking down of urea owing to the presence of bacteria.[7] The solution has no color or odor; consequently, the addition

of an inert coloring material to distinguish it from water or salt solution has been found advisable. An initial concentration of 1 per cent was changed early in the work to 2 per cent, and this strength was used throughout most of the tests. A considerable latitude exists in the concentration which can be used effectively, a solution as high as 10 per cent appearing to hasten healing in resistant cases.

Urea can be administered conveniently on gauze dressings thoroughly saturated with the solution and applied loosely to the wound. To retard drying the dressings are frequently covered with waxed paper or oiled silk. In deep pockets or inaccessible places the solution can be injected with a medicine dropper or ear syringe. The dressings are changed daily or when soiled.

Occasionally extensive applications are required and the ordinary methods of local treatment then are not feasible; for instance, in the treatment of extensive secondary infections of the skin following injury by poisonous plants, insect attack, heat burns or sunburn. The suggestion here is made that under these circumstances it would be more effective to immerse the body in a warm urea solution prepared in a bathtub. It is well to note, in estimating the duration and number of immersions, that urea is effective only for the time it is on the lesions and that it is readily absorbed and removed. In setting the temperature of the bath, allowance should be made for the cooling effect of urea when being dissolved. One-half pound of urea crystals to about forty gallons of water makes a solution somewhat less than ¼ per cent concentration.

In a greaseless ointment base, urea is giving excellent results in the treatment of ambulatory cases and under conditions where saturated gauze dressings would be uncomfortable. A greasy base should be avoided as it would interfere with the action of urea. A vanishing cream or greaseless type of ointment is satisfactory. The urea is easily combined with the ointment by thorough mixing, and as much as 15 per cent of urea can be added in this way. A fairly firm type of ointment should be used, as the urea tends to soften it. The suggestion has been made that urea added to surgical lubricating jelly and put in collapsible tubes might be found serviceable and not subject to contamination when used by patients. The addition of 15 per cent of urea is easily made and apparently does not affect the characteristic properties of the jelly. In both the ointment and the jelly the urea goes at once into solution in the water which is present.

Urea appears to act only while in contact with the tissues to be treated and the healing effect does not persist. It also seems to exert a local effect only. It must, therefore, be applied directly to the affected tissues.

This method of treatment is easily given and requires very little time. The treatments are usually painless in themselves and appear in some cases to relieve pain which is present in the wound, reducing the need of sedatives. No other chemical should be used in the wound during the treatment. Where indicated, debridement should precede treatment.

Urea is bland, stable and non-toxic, and no report of ill effect from the treatment has yet been received. It can be prepared in a highly concentrated solution if desired, as high as 40 per cent. This makes it easy to ship in solution and only requiring dilution before use. It can be purchased in one-pound bottles or in five to twenty pound cans through local pharmacists or directly from chemical manufacturers. The price at present is about fifty cents a pound which is low enough to make extensive use of urea quite practicable. Ten daily treatments of an average size wound cost about one cent for the urea. It is available in large quantities, the output of companies making urea for soil fertilization is sometimes as great as one hundred tons a day.

Although the pyogenic infection of the wound is noticeably reduced during the treatment, repeated laboratory tests have

failed to show that the 2 per cent concentration of urea used clinically has any direct bactericidal action on the organisms involved in chronic purulent wounds. Additional tests have been made with concentrations as high as 8 per cent with similar negative results. Removal of necrotic material from the wound is also evident during treatment. Urea, however, has no direct proteolytic action. In concentrated solutions urea acts as a solvent of non-viable material, but in the present experiments it has been used only in dilute solution. Thus the cleansing effects obtained are not attributed to any direct activity of the urea. It has been noted, on the other hand, that the urea treatment does stimulate the proliferation of the cells of the granulation tissue and the development of capillaries. A conclusion to be drawn from this is that the cleansing effects are produced indirectly through the stimulation of a vigorous growth of granulation tissue with abundant blood supply.

It appears to be a matter of common knowledge that in Europe, Asia, Africa and also in America, urine is used on wounds to prevent infections and to stimulate cleansing and healing. This practice has lasted at least since medieval times. Like various other remedies for human ills which were used at that period, the application of urine to wounds might seem to be fantastic and ineffective. The concentration of urea in human urine is approximately 2 per cent, however, and thus this remedy for non-healing wounds now appears to be basically sound.

It is unfortunate that urea is generally associated with animal excretions. Consequently the lay attitude toward urea, even as a treatment for external wounds, might be difficult to overcome. As a matter of fact, urea is of common occurrence in plants, some of which are used as food. It so happened that Fourcroy and Vauquelin,[3] who gave urea its name, first found it in urine, and they called it "urée," thus stigmatizing it in public opinion. If this substance had first been isolated in spinach, in which it occurs,[7] its name would have been something entirely different and it would no doubt be regarded without prejudice.

Under the circumstances it would be well to explain that urea, as used therapeutically, is a manufactured product which can be made from three gases occurring in the atmosphere and that it has no connection whatever with animal excretions. Nitrogen is obtained from the air; hydrogen, by passing steam over hot coke in the presence of a catalyzer which removes the oxygen; the N and H are combined to form ammonia, NH_3, another gas. Under high pressure and low temperature ammonia is liquefied and combined with carbon dioxide, CO_2. Urea, $CO(NH_2)_2$, which is finally obtained, is a pure white crystalline material. It is of interest here that urea was the first organic substance ever synthesized; Wöhler[8] produced urea in his laboratory a little over a century ago. That organic compounds could be produced synthetically was an epoch-making discovery.

In 1912 Calkins et al,[1] in testing the effect of various metabolic substances on the rate of cell division of the protozoan, *Actinobolus radians*, found that when the seasonal vitality of the cell was high allantoin did not increase its rate of division, but when its vitality was low allantoin had a marked stimulating effect, causing the cell to reproduce nearly twice as fast as the checks. From the present and the previous[6] investigations, allantoin and urea are apparently alike in activating the indolent, edematous tissues of purulent lesions and promoting development of granulation, a characteristic somewhat similar to that found by Calkins.

According to Marshall and Davis[5] and Fearon,[2] urea is found in all the organs and tissues of the body. It occurs in approximately uniform concentration except in adipose tissue in which it is lower, and in renal tissue in which it is higher. The normal urea content of the blood is about 0.018 per cent. A rise or fall in the urea concentration of the blood and lymph is accompanied by a corresponding change in

that of the tissues. The cells are able to absorb large quantities of urea as readily as small and the diffusion of it to the various parts of the body occurs rapidly. It is non-toxic except in enormous doses. Marshall and Davis also refer to the work of Gryns,[4] who states that solutions of urea readily permeate the membrane of all kinds of cells; that when cells are placed in urea solution the concentration within, at once becomes the same as without; and that urea can never cause hemolysis.

On the one hand, it appears that the tissues are perpetually supplied with urea, which in sufficient concentration is a potential stimulator of healing processes. On the other hand, the existence of chronic purulent lesions indicates that the 0.018 per cent concentration of urea in the blood is incapable of promoting healing as do external applications of 2 per cent. Either the concentration in the blood is insufficient or its effectiveness is reduced by conditions in the wound. The effect of the 0.018 per cent concentration of urea on the normal growth and reparative processes of tissues remains to be investigated. The low concentration maintained in the tissues and the constant excretion of a large excess indicate an equilibrium at that point. At any rate, the popular idea of urea as a waste product in the body has tended to obscure the conception of it as a cell proliferating and healing material.

SUMMARY

Urea has been found to stimulate healing in chronic purulent wounds. The effects obtained are a cleansing of the wound by the removal of necrotic material and pyogenic bacteria present, and a promotion of the growth of granulation tissue.

Like allantoin, urea occurs in maggot excretions and its presence serves as a further elucidation of the remarkable efficiency of surgical maggots in healing chronic suppurating wounds.

This healing action of urea probably accounts in part for the custom prevalent for centuries in Europe, Asia, and Africa, and also practiced in America, of using urine to promote cleansing and healing of wounds.

Urea, which is manufactured in enormous quantities for use as a soil fertilizer, is available for therapeutic use without any connection with animal excretions. It can be made from three simple gases, nitrogen, hydrogen and carbon dioxide, and is a pure white crystalline substance. In wound treatment a 2 per cent solution in water has been used on saturated gauze dressings applied directly to the wound. The solution is bland, odorless and non-toxic. The treatment is very inexpensive and easily given.

Urea is present in the cells of all the tissues of the body; it rapidly permeates the membranes of the cells and its concentration therein rises and falls readily with that of the blood and lymph. In view of the remarkable cleansing and healing properties of urea in chronic purulent wounds, it appears that the general conception of this material as only a waste product has tended to obscure its therapeutic character.

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MEDICOLEGAL ROLE OF TRAUMA IN BRAIN TUMORS*

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IN SPITE of our increasing knowledge of brain tumors the diagnosis, prior to death, is still made relatively infrequently. The diagnosis was made in only 3 instances of 29 cases observed in the course of 1642 autopsies. The classical cardinal symptoms are very frequently lacking. Thus, there is no increased intracranial pressure nor is papilledema present in about 15 to 30 per cent of cases and headache is absent in about 10 per cent of cases. In those cases in which the cardinal symptoms are present, headache, vomiting and choked disc have been found to be present together in about 60 per cent of cases.

The role of trauma is rather involved. The matter is becoming increasingly important from the point of view of Workmen's Compensation, personal accident claims and negligence actions involving automobile accidents. The separation of the effects of trauma from disease may be difficult to prove to the lay mind of a jury. Competent producing cause and effect may be reconciled in court cases, especially if reasonable doubt as to the true etiologic factor of the disease is injected by an astute counsel. When injury is involved, in the lay mind, a certain pathology may be linked with its genesis, whereas, in many cases, the accident was a coincidence or merely brought the lesion to the threshhold of observation by the claimant.

In the German literature appears a report by Reinhardt of an unique case worthy of special mention:

A piece of wire was found in a tumor enucleated postmortem from the brain of a 58 year old male, who had died, after an illness of about four years. This started with headaches in the parietal and temporal regions, described as "something working out" and associated with gradually increasing blindness and loss of olfactory sense. On admission to the asylum, the patient showed a temporal atrophy of the right papilla and a total atrophy of the left; irritability, querulousness, loss of ethical sense, tendency to clownish tricks, aggressiveness and uncleanliness. Diagnosis, tumor of the frontal lobe. The evolution was marked by gradually increasing incontinence, apathy, confusion and disorientation, complaints of abdominal pains,—finally, complete indifference, cachexia and death. Autopsy: Carcinoma of the pylorus, atrophy of the heart, pulmonary emphysema. The brain was removed in toto. A tumor the size of a tangerine was enucleated from between the frontal poles and the chiasma. It had displaced the base of both frontal lobes without invading the brain substance, except, the adjacent orbital convolutions, which were somewhat split and abnormally soft. On the left side, the tumor adhered slightly to the meninges. The sections of the brain itself were very hemorrhagic, showing, at the convexity, behind the two frontal poles, superficial meningeal hemorrhages, cord-like thickened pial veins, and flea-bite hemorrhages in the adjacent cortex and subcortical marrow. A sagittal section through the enucleated tumor at its frontal base revealed a piece of wire twisted in a spiral with a second, smaller, piece wound twice around its frontal end, embedded in calcified tissue. Microscopically, the tumor was a sarcoma. By quizzing the deceased's wife, it was learned that, on the occasion of a boiler explosion in 1898, the man had been wounded above the left eye, by a flying piece of water gauge. The wound, which bled abundantly had healed without treatment and without interruption of work. The wire may have penetrated directly through the wound, if the bone was injured. Unfortunately, the autopsy did not include an examination of the skull. It is quite possible that the man was not incapacitated in spite of an injury of the skull, because similar injuries often cause unpro-

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portionately insignificant symptoms. On the other hand, the foreign body may have penetrated through the nose, unnoticed, in the general confusion, the more impressive bleeding wound distracting attention. Haymann states that this often occurs, and that such foreign bodies are liable to wander as far as the ethmoid bone. But no matter how the foreign body in this particular case penetrated, it remained latent at the frontal surface of the brain, for years. A granuloma gradually formed around it, the cells of which underwent blastomatous degeneration, and what with age, the continuous irritation and probably also an individual predisposition, as indicated by the presence of a carcinoma of the pylorus, a sarcoma of the meninges developed. A latency of 20 years is not at all unusual for a tumor caused by irritation of any kind (Fischer-Waserls). Up to 1928 this writer could find only 2 similar cases in the literature, namely, Leszynski's case of post-traumatic endothelioma of the brain, in which a bone splinter was found detached from the tabula interna, and Fischer-Waserls' case, in which a needle embedded in an old suppurative focus was found in the middle of a carcinoma of the breast.

Legal counsel, who assays to review the older medical literature on this subject, is often baffled by conflicting opinions of eminent authorities. Two excellent articles dealing with trauma and brain tumor have appeared, by Holmes in 1904 and Reynolds in 1923. The former collected 30 opinions and briefs of "brain tumor cases caused by accident," excluding cysts. Reynolds cites 3 cases of Mr. Geoffrey Jefferson, who doubts if a single trauma can start a brain tumor and thinks it more likely when it apparently does so, it is only by "stirring up a growth which was already present." Reynolds relates 2 cases, in which he was unable to decide whether causal relationship or the incalcuable factor of coincidence existed. These opinions, however, are now being clarified. Thus, the "Relation of Injury and Glioma of the Brain" has been made an exhaustive study in 1931 by the Mayo Clinic. This article deals with trauma as a possible, primary factor and entirely annihilates any existing theories which may have been promulgated in an attempt to link up causal relationship. The authors, Parker and Kernohan, set definite criteria modified from what Ewing described as postulates of the French Statutes, as follows:

1. The head injury must be of reasonable severity.
2. It must have been established beyond doubt that the patient had had no symptoms or signs suggesting cerebral disease before the occurrence of the injury.
3. There must be a latent period of at least a few weeks between the date of injury and the first appearance of progressive symptoms suggesting cerebral tumor; the patient need not be free of symptoms during the latent period, but progression of symptoms must date from the injury.
4. There must be microscopic proof of the existence of tumor.
5. The rate of growth of the tumor as estimated by current standards must be in correct relation with the period of time elapsing between the injury and the earliest microscopic diagnosis of tumor. It is obvious in so controversial a subject that any law laid down is open to discussion, but some set of standards must be accepted before direct cause and effect is assumed.

According to these standards 431 cases of glioma of the brain were studied. There were in all 21 complying cases, giving a history of head injury in 4.8 per cent. Adler, in a probably less critical analysis in 1898 found about twice this percentage in 1086 cases. Parker and Kernohan also studied 435 patients afflicted with various diseases other than brain tumor as a control; 10.4 per cent in this series gave a history of head injury. In a third study 200 presumably normal individuals were examined who admitted head injury in 35.5 per cent. The relative severity of injury was greatest in the last group. These writers conclude that "The statement that patients with glioma, who have a history of injury to the head, means nothing and that the incidence of injury to the head can have no influence as an argument for causal connection." In support of the belief of

these authorities, 2800 odd cases of injury to the head, occurring since 1918 in civil and military practice, observed for a period of twelve months to two years, were analyzed and in none of these was there a record of glioma developing as the direct result of these injuries. They finally concluded that its occurrence merely comes within the possibility of coincidence.

Dr. Charles H. Frazier, who opened the discussion of this paper, quoted E. Muller's incidence of 70 per cent of frontal lobe glioma with trauma as an etiologic factor. Gerhardt found trauma in 10 of 60 brain tumors. Frazier studied 87 frontal lobe tumors and found trauma in 15 per cent, in none of which, in his opinion, was injury of any significance whatsoever.

There is still, however, considerable opposition to these views. The reports of Neuburger in 1925 indicate that he considered his 2 cases the first to be recorded in which the principle of traumatic origin of glioma had been supported by direct evidence. Von Monakow believed in the traumatic genesis of brain tumor. How can these affirmative views be reconciled with studies by Martland who described in "Punch Drunk" degenerative changes in prize fighters but no brain tumor as the result of repeated blows upon the head?

Dr. W. B. Cadwalader in the further discussion of Parker and Kernohan's paper stated, "No absolute evidence, as proved by biologic or histologic study, exists that trauma can possibly cause proliferation of these cells, and I think it is fair to conclude that at the present time it is an impossibility for trauma alone to do it."

In the final closure of the discussion, Dr. Parker stated that no evidence of the old injury per se was ever found at autopsy or operation. He tabulates the location of the injury in relationship with the location of the tumor as follows: "Among the fifty-eight cases the site of the tumor was unknown in ten, and in nine it was directly under the area of injury. In fifteen cases it was reasonably close; in twenty-four it was remote." Dr. Parker, said that the site was of no significance as the defenders of the trauma theory can twist the question of site to suit themselves; thereby evoking diffuse spread by contre coup or other means of transmission.

Beneke was of the opinion that 40 per cent of brain tumors was caused by either direct or indirect trauma, capable of establishing either direct or indirect reflex ischemia of the brain resulting in necrosis of glial tissue, which *might* be the cause of glioma. The law fortunately, however, does not deal with what might happen or possibilities, only probabilities.

Hoppe is of the opinion that

> . . . there can be no doubt that trauma to the head sufficiently severe to produce fracture or concussion can be the immediate and direct cause of tuberculomata and gummata by creating favorable soil, namely bruised brain tissue for the development of these two growths. In every case, however, there should be a chronological relation between the accident and the gradual onset of the symptoms culminating in the symptom complex of brain tumor. There is hardly a scientific basis for causal relation between trauma and other forms of brain tumor, especially when we consider the enormous frequency of concussion of the brain with or without fracture and the relative infrequency of brain tumors.

Cushing argues that when tumor symptoms follow immediately trauma, it later serves only to bring into the open the presence of a previously obscure growth. This is caused by the rupture of a blood vessel in a vascular glioma or by concussion edema. This opinion was also confirmed by autopsy studies by Starr.

Pegoraro in 1932 made a study of the frequency of trauma in glioma. He shows that brain tumors are more frequent in males even in infancy where exposure to trauma is alike in the two sexes. This author studied 107 cases. A true relationship existed in 6 cases which, however, critical analysis reduced to 3 because of the fact there were no corroborative autopsies in 3. Of the former, one was a tuberculoma of the cerebellar vermis which showed in-

jury to the left parietal region when a hand grenade exploded. This was preceded by no disturbances and eventuated in death some months later. The second case was a man of forty-five years who at the age of thirty-nine years was hit over the head with a cane and suffered lacerations and contusions in the sincipital region. He noted no disturbance in the following five years but subsequently he had intense headache, vomiting and convulsions. The autopsy revealed a neoplasm of the frontal lobes. The third case was a male, age thirty-one years who fell from his bicycle when he was twenty-six years old, suffering a severe concussion of the brain. Three years later he fell from a truck and again suffered a severe concussion and injury to his neck. At the age of thirty years he began to suffer from intense headache, insomnia, vertigo and vomiting. The autopsy revealed a tumor of undetermined nature of the white substance of the right semioval center.

The following case report is presented. Settlement of a death claim has been effected and the story can now be told without detriment to the defendant casualty company.

P. M., aged forty-two years employed as an automobile truck driver, was admitted to the Presbyterian Hospital on May 25, 1933 on the afternoon of the day of the alleged accident. His temperature was 99°, pulse 80, respiration 20. He first stated that his horses ran away and he was thrown from his truck striking on his head upon the pavement. This was obviously incorrect and was later changed to a fall from his truck, a distance of six feet landing in a sitting posture on his buttocks upon the sidewalk. He became dazed but not unconscious. He continued his work and later in the afternoon vomited. His chief complaints upon admission were headache and loss of memory. Examination revealed a large obese adult male, who was conscious, irritable, restless and semi-oriented. Complete physical examination revealed no signs of external injuries. The only positive finding was tenderness over the dorsal spine and a small sinus, one-half inch in depth, in the midline of the coccyx. The working diagnosis was possible fracture of the base of the skull by contre coup. The nurse's notes indicated involuntary bowel movements. *X*-ray films of the skull and spine showed no traumatic bone pathology. Examination of the eye grounds was negative. The clinical diagnosis was mild concussion of the brain and pilonidal sinus.

The patient was discharged on May 29 and referred for further observation. On June 5 he reported complaining of headache. He stated that on June 1 he became dazed while walking in the street but supported himself and proceeded to his home. Examination on this date revealed blood pressure 140/85 pupils were equally contracted and showed sluggish reactions to light and accomodation. He was referred for reexamination of his eye grounds and for Kahn and Wassermann reactions, both of which were reported to be negative. On June 10 he was readmitted and when examined was found to be unconscious, the blood pressure was 145/95. The left pupil was larger than the right and both were contracted. Abdominal reflexes were absent. Blood examination showed 16,000 leukocytes with 80 per cent polymorphonuclear cells. Spinal fluid count was 8 cells. During preparation to operate under the suspicion of a possible fracture of the skull, which had been overlooked, the patient died at 3:45 A.M.

Autopsy disclosed that the skull was of normal thickness and showed no fractures. It was uniformly vascular and contained large blood sinuses. The dura was also very vascular and bled easily. The pia-arachnoid vessels were engorged with blood. The cerebrum was evenly compressed against the cranium. The convulutions were flattened. In the middle of the base of the brain there was an isolated, oblongate tumor of very firm consistency, resting upon the pons, 1½″ long and ¾″ in thickness. One extremity was attached to the middle of the circle of Willis by thin fibrous adhesions and the other extremity pressed against the upper portion of the dorsum sella, producing marked erosion of the left posterior clinoid process. The pituitary body was normal; the pons flattened, but the cerebellum, medulla and cord were free and clear. Histologic examination reported by Dr. H. S. Martland showed meningioma.

The writer was asked to analyze this case in defense of a formal petition filed in the Workmen's Compensation Bureau and

entered against the employer. The salient features are: (1) The accident, occurring on May 25, was reported, the diagnosis of which was mild cerebral concussion. (2) Neurologic examination, *x*-ray of the skull, Kahn and Wassermann tests and eye grounds gave no focal signs of brain tumor. (3) Six days after discharge from hospital the patient became dizzy while on the street. He was readmitted after sixteen days with increased intracranial pressure but died while preparations for a decompression were being made. (5) The Essex County Medical Examiners' Office gave the cause of death "Brain Tumor."

A broadened interpretation of the Compensation Law now includes all cases in which trauma is held to be a contributing factor insofar as it may influence unfavorably the course of a disease from which the patient was suffering at the time of the alleged injury. Formerly awards were made for only the direct effects of trauma or occupational diseases. It has now become complex as new interpretations have in effect made the law subject to the scrutiny of indirect effects of trauma upon the diseased parts.

Decisions, therefore, based on the aggravation theory, rest not upon proved scientific facts but largely upon speculative opinions. These opinions, expressed in court, are subject to wide variation and are often flatly contradictory. It is not surprising, therefore, that juries are bewildered when eminent authorities are quoted.

While it is true that the cause of death was given as "Brain Tumor" and while it is equally true that no traumatic pathology was present at autopsy, the possible causal relation of trauma to death can not be lightly disregarded.

Trauma, as a factor in the production of death from brain tumor in this case should be viewed from three angles: (1) as a primary inciting factor; (2) as a secondary contributing or aggravating factor resulting in increased growth of an already existing tumor; or (3) in the production of other pathology within the substance of the growth or in the surrounding structures. Histories of tumor cases are replete with instances in which injury preceded the diagnosis of these growths. Such an occurrence may first center attention upon a growth. It is probable that no claim could be justly made that trauma caused the brain tumor. As a direct exciting cause, a single solitary blow is denied (Ewing). It is manifestly impossible for such a tumor to develop in sixteen days, deep seated and well protected as it was within the bony cranium even had direct injury to the head been sustained. If, however, an attempt to prove direct trauma as a primary cause is injected, the defense should be prepared to combat even that fantastic allegation. The exact microscopic diagnosis of the neoplasm is, therefore essential in view of the acknowledgment of traumatic influence by some in certain types of tumors. The second hypothesis grants the prior existence of a tumor but may seek to prove either increased cellular growth, hemorrhages into the substance, a rupture elsewhere of its blood vessels or a concussion edema in the parts immediately surrounding the growth. The case falling within this category, based on the aggravation theory, is difficult to defend. Opinions will differ and decisions vary properly with the evidence deduced under individual circumstances. Glioma is particularly vascular. Blood vessels being more delicate, they are prone to traumatic rupture because of the thin walls either from direct or indirect application of force. It was very important in this case to know whether hemorrhages existed in the substance of the tumor on either gross or miscroscopic examination and the degree of surrounding edema. It is fortunate for the defense in this particular case that no recent hemorrhages were reported within the substance of the tumor.

It is generally conceded that medullary compression is the exact mechanism of the immediate cause of death brought about in the absence of trauma, by increased

growth of the tumor and resulting in increased intracranial pressure due to confined, rigid, bony walls. This is a natural sequence of pathological changes of unchecked, malignant growths. We may inquire, granting the tumor antedated the accident, "Did the man fall because he became dizzy or did he actually overreach in grasping a box, slip and fall in a sitting posture on the buttocks upon a cement walk?" The accident, I believe, has never been corroborated by witnesses. Let us assume that he did so fall—What happened to him? Force, thus applied in the case of a man weighing 220 pounds, is transmitted upward along the spinal column to the base of the brain where the tumor is located. This application of force resulted in the disturbance of the cerebral circulation—a cerebral concussion, for he vomited. The following additional reasoning is justified: From microscopic examination we have knowledge that in the absence of trauma, brain tumors, because of the encroachment upon neighboring tissues through growth are surrounded by an area of disturbed circulation, namely edema. This edema, in turn, results in increased intracranial pressure. When this pressure within the skull increases to a sufficient degree, the medulla is completely shut off and death results from respiratory and circulatory failure. Given this actual pathology, plus trauma, it is readily conceivable that a jar, indirectly transmitted through the bony structure of the spine to the base of the brain and resulting in a disturbed cerebral circulation and acting upon tissues already the seat of disturbed circulation (congestion and edema) would tend to still further effect adversely the already handicapped brain. Furthermore, it is conceivable that the jar might actually rupture blood vessels within the growth.

This line of reasoning, if brought out for the petitioner, cannot be denied. The tumor was not caused by the injury nor was it stimulated to increased growth by the fall. There is no evidence that hemorrhages occurred in the tumor or that the neighboring blood vessels were ruptured. It is, therefore, probable that trauma if applied, aggravated the already disturbed cerebral circulation, increased the existing edema eventuating in increased intracranial pressure and thus contributed to the immediate cause of death. It is certain that the man's days were numbered. How long he would have lived, if no accident had occurred is purely speculative. His life might have been prolonged for years by a timely decompression, but on the other hand, he might have died from the effects of an operation. It is urged, therefore, that if settlement of this case can be effected, it should be entertained, for it is difficult to defend. If this is to be a jury trial, laymen might even give consideration to the injury as a direct exciting cause of the growth because the cause of the tumor is still unknown. This confession of ignorance by the profession engenders conjecture. "No one knows the cause of tumors. Why not give this poor widow the benefit of the doubt—the Insurance Company is rich and can well afford to pay." Thus an additional factor of sympathy is possibly brought into the case.

The Defendant was able to effect a settlement in the amount of $1300.00.

SUMMARY

1. In dealing with primary causes, trauma, as a factor, should be denied, unless very critical requirements are met.

2. Solitary application of trauma is not a cause, per se, of brain tumors. Even repeated applications seem to have no influence.

3. The theory of chronic irritation of a foreign body plus a suitable anlage appears to have some sponsorship.

4. In the majority of cases of brain tumors with a history of antecedent trauma, it is probable that there is no causal connection.

5. To trauma, as a factor, in the production of death, however, in a case of brain tumor, may be traced a very definite relationship.

LUMBAR PUNCTURE IN HEAD INJURIES

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IN head injuries the withdrawal of cerebrospinal fluid by lumbar puncture has been advocated by some authorities, both as a diagnostic procedure and a therapeutic measure to reduce intracranial tension.

There is a sharp division of opinion regarding the value and safety of this procedure, which was instituted by Quincke[1] in 1905. Munro,[2] Jackson[3] and Fay[4,5] are among its strong advocates. McClure and Crawford[6] believe it should be performed in selected cases and Connors[7] recommended its use as a diagnostic procedure. Other authorities, however, notably Dandy[8] and Besley,[9] have opposed this procedure not only as futile but also as dangerous. They maintain that the sudden reduction of intracranial tension is likely to start intracranial hemorrhage which had been controlled by the tampon-like action of that tension, and to cause brain strangulation by a sudden dropping of the brain stem into the foramen magnum. Gumprecht in 1900 collected 17 cases of sudden death following lumbar drainage and autopsy showed them to be caused by the pressure of a tumor. Many of these cases were punctured in the sitting position and 15 c.c. to 60 c.c. of fluid withdrawn at one time. Schoenbeck[10] in 1918 collected 71 cases of death following lumbar puncture, and in 67 autopsy revealed a tumor or other chronic brain disease.

The confusion caused by these conflicting opinions has resulted in a skepticism and has led to a policy of "do nothing" in the handling of these cases. A study of the anatomy and physiology of those parts of the brain concerned with the secretion, excretion and circulation of the cerebrospinal fluid, together with a critical analysis of cases of head injury, should go far towards reconciling these conflicting opinions and should indicate a rational middle ground which the surgeon may follow. To clarify this confusion is the purpose of this paper.

It is a well known fact that the brain, which is contained in a rigid, bony box, is incompressible and the relief of intracranial tension can only be obtained by diminishing the fluid contents, the arterial and venous blood, and the cerebrospinal fluid.

The arterial blood supply is derived from the two internal carotids and the two vertebrals, which together form the circle of Willis. Anastomoses exist between the vertebral arteries, through the anterior and posterior spinal arteries, and the intercostal arteries and other branches of the descending aorta. In a dog, both carotids and vertebrals may be ligated without causing unconsciousness and death, whereas in man ligation of both carotids is probably fatal.

The venous sinuses, which are protected by the cranium and a tough dura against compression, are peculiar to the brain. The larger cerebral veins open into these sinuses. The openings have no valves but are protected from closure by the structure of the dura mater around the orifice. (Howell.)

The cortical veins, which are a frequent source of hemorrhage, are thin walled and elastic, to allow their participation in the normal variations of intracranial pressure. They are situated in shallow grooves on the surface of the brain and consequently are inadequately protected; and are readily ruptured with or without actual laceration of the brain substance. (Rawling.[11])

Cushing[12] has pointed out that many of the frontal and parietal veins drain into the superior longitudinal sinus in an upward direction. They leave their partially protected beds in the sulci to enter the sinus. In this region they are unsupported and liable to rupture.

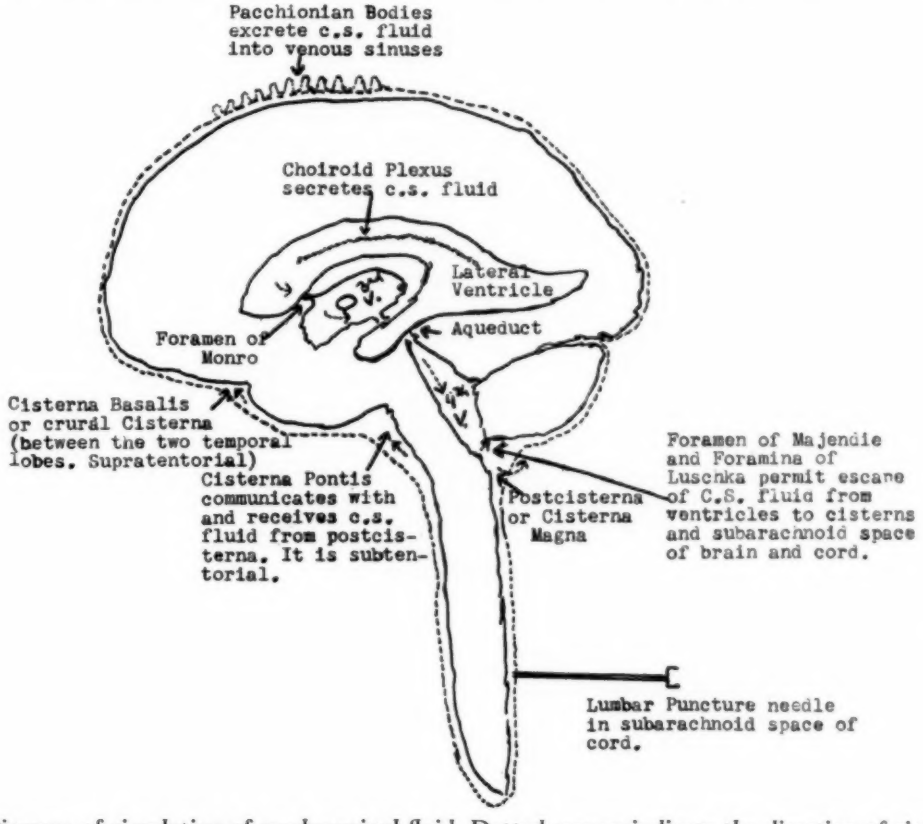
Pacchionian Bodies excrete c.s. fluid into venous sinuses
Choiroid Plexus secretes c.s. fluid
Lateral Ventricle
Aqueduct
Foramen of Monro
Cisterna Basalis or crural Cisterna (between the two temporal lobes. Supratentorial)
Cisterna Pontis communicates with and receives c.s. fluid from postcisterna. It is subtentorial.
Postcisterna or Cisterna Magna
Foramen of Majendie and Foramina of Luschka permit escape of C.S. fluid from ventricles to cisterns and subarachnoid space of brain and cord.
Lumbar Puncture needle in subarachnoid space of cord.

Fig. 1. Diagram of circulation of cerebrospinal fluid. Dotted arrows indicate the direction of circulation.

The cerebrospinal fluid is a thin watery liquid with a specific gravity of 1007 to 1008, which is less than that of the blood, and a pressure just above that of the venous system. Its function, aside from acting as a waterbed or shock absorber, is to carry off metabolic waste products. Dandy[13] thus describes the function of the cerebrospinal fluid:

> It is the generally accepted belief that the chief function of the cerebrospinal fluid is to protect the brain and spinal cord from the ordinary and extraordinary shocks to which these important structures are subjected. The existence of great waterbeds around the most important parts of the nervous system—the medulla, spinal cord, pons and midbrain—would seem prima facie to furnish sufficient proof of the protective function. Moreover, the prominent bony irregularities along the base of the human skull would appear to require a buffer against constantly recurring shocks.

The ability of waterbeds to protect their enclosed structures must lie in the ready displacement of fluid, for, being almost totally incompressible, water cannot absorb shocks as can an elastic body. The effects of a localized force are diminished by a loss of fluid at the pole of impact and by transmission of radial waves of fluid to more distant parts. The amount of injury which results locally and at a distance will, therefore, be dependent upon the severity of the blow and the amount of fluid at the site of the blow. A severe impact produces such rapid radiation of fluid waves that an explosive effect results.

The cerebrospinal fluid is secreted by the choroid plexus in the lateral ventricles. There are two theories relative to its formation, active secretion and dialysis. It is also partly derived from the perivascular systems. It is excreted by the arachnoid villi

and Pacchionian bodies and by the lymph spaces under the arachnoid sheath of the cranial nerves. Fremont-Smith[14] states, "There is good evidence that the mechanism of absorption through the arachnoid villi is determined by the relative hydrostatic and osmotic pressures of the cerebrospinal fluid and the blood in the dural sinuses." Weed,[15,16] states that "absorption of cerebrospinal fluid from the cerebral pathways is much greater than that from the spinal cord."

In order to understand the circulation of the cerebrospinal fluid it is important to keep in mind the anatomy of the ventricles, subarachnoid space and cisterns. This has been represented diagramatically in Figure 1.

The two lateral ventricles communicate with the third ventricle through the foramen of Munro. The third ventricle communicates with the fourth through the aqueduct of Sylvius, and the fourth ventricle communicates with the subarachnoid space, which has several cisterns through the foramen of the Magendie and the foramina of Luschka (Key and Retzius). Closure of these foramina or of the aqueduct leads to internal hydrocephalus.

The subarachnoid space receives the fluid after leaving the ventricles, and from it the fluid is excreted by the arachnoid villi and Pacchionian bodies. Key and Retzius believed that the cerebrospinal fluid passed normally from the subarachnoid space into the subdural space about the Pacchionian granulations, and from this directly into the sinus. The pathway was not through endothelial cells but through stomata between these cells. Absorption of cerebrospinal fluid depended in their conception of the process, upon two factors: osmosis and difference in pressure between that of the subarachnoid fluid and that of the cerebral sinus.

Reiver and Schnitzler in 1894 furnished physiological proof of a venous absorption of cerebrospinal fluid. They state that, as Pacchionian granules do not occur in the animals they used, other pathways of absorption into the venous system must exist. This view of absorption directly into the veins was corroborated by Leonard Hill, Spina, and Cushing.[17] Mott believed that the cerebrospinal fluid was absorbed into the peri-capillary spaces of the cerebral capillaries. Cathelin in 1912 described what he believed to be a veritable circulation of cerebrospinal fluid, and Goldmann believed that cerebrospinal fluid escaped via the perivascular lymph spaces about the cranial vessels.

The subarachnoid spaces of the brain and cord communicate freely. The space is intersected by septa of connective tissue, tearing of which leads to the formation of adhesions which are responsible for later complications. The advocates of air injection following the withdrawal of cerebrospinal fluid maintain that the air thus injected forms a cushion in the subarachnoid space and prevents the formation of adhesions. It is in free communication throughout the brain cord, so that lumbar puncture and withdrawal of fluid from the subarachnoid space of the cord will affect the pressure and amount of the fluid in the subarachnoid space of the brain.

There are several large subarachnoid spaces in which cerebrospinal fluid accumulates. These cisterns or reservoirs were described by Toldt. The most important ones are the Cisterna Magna or postcisterna, located posterior to the medulla, and into which the fluid enters after leaving the fourth ventricle, and the cisterna pontis which communicates with the cisterna magna and is a continuation upward of the anterior part of the subarachnoid space. There are several other cisterns well described in textbooks on anatomy which need not be enumerated. Fay and Winkelman maintain that the fluid after leaving the cisterna pontis passes anteriorly through the subarachnoid space of the incisura tentorii to reach the cisterna chiasmitus and thence reaches the frontal and parietal lobes where it is absorbed by the Pacchionian bodies. These authors maintain that the normal circulating field

does not include the temporal or occipital lobes. It is important to keep in mind that the tentorium cerebelli acts like a diaphragm subdividing the intracranial cavity into a supra and an infratentorial region, which communicate through a narrow aperture, the incisura tentorii through which the mesencephalon passes. Cerebrospinal fluid must pass from the sub to the supratentorial region in order to be absorbed. Jackson states that

> a slight hemorrhage or swelling of the cerebrum or midbrain blocks the cerebral subarachnoid space, and the fluid cannot be absorbed along its natural channels. The fluid no longer rises above the tentorium but collects in the basal cisterns and in the ventricles, and stasis results. The enlargement of the basal cisterns forces the midbrain up and further occludes the narrow subarachnoid space in the incisura tentorii. The enlargement of the lateral ventricles above the tentorium forces the cortex of the brain still more against the dura, and unless the excess of fluid is withdrawn from below the tentorium, a dry flattened cortex is found at autopsy.

Gravity permits trickling of extravasated blood through the incisura into the subtentorial region and this is another factor in producing compression of the brain stem where the vital centres and the nuclei of most of the cranial nerves are located. Compression of the supratentorial part of the brain is relatively harmless, whereas an equal compression of the subtentorial portion is fatal.

The cisterns normally contain about 60 c.c. of cerebrospinal fluid, the lateral ventricles about 30 c.c. and the subarachnoid space of the cord about 30 to 60 c.c. The fluid is rapidly formed from the blood, and is also quickly absorbed into the blood stream. In pathological states the amount of fluid is greatly increased.

Pacchionian bodies occur in numbers which vary with the individual and with age, and are found along the sinuses, especially the superior longitudinal sinus. Each body is a minute pear shaped protrusion of the arachnoid membrane into the interior of a sinus as represented in Figure 2 based upon Howell's description.[18] Arachnoid villi are distinct from Pacchionian

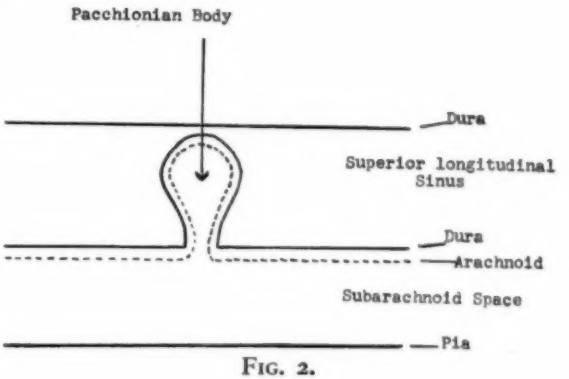

Fig. 2.

granules, Weed states, "the Pacchionian granulation must be considered as a large, hypertrophic villus, becoming evident on macroscopic examination in most adults. While no Pacchionian granulations are found in infants, arachnoid villi are invariably met with in normal children."

The spongy tissue of which the Pacchionian bodies are composed is continuous with the trabecular tissue of the subarachnoid space, so that fluid injected into the subarachnoid space finds its way into the Pacchionian bodies; and through their coverings filters into the superior longitudinal sinus (Gray[19]). Through these bodies the cerebrospinal fluid is brought into close contact with the venous blood, the two being separated by a thin layer of dura and the very thin arachnoid. Weed states that in adult life the Pacchionian bodies are arranged in six principal collections close to the superior longitudinal sinus, the other groups occurring scattered throughout the craniovertebral cavity. Key and Retzius reported that the Pacchionian granulations occur in the following situations in order of frequency: superior longitudinal sinus, transverse sinus, cavernous sinus, superior petrosal sinus and vena meningia media.

Another factor which has contributed to the divergence of opinion regarding the results of lumbar puncture is the lack of classification of head injuries into groups

based upon the nature and extent of injury. A therapeutic measure which may be beneficial in one group may be harmful in another. Similarly, mortality statistics of various authors are of little value unless a method of classifying head injuries is adopted universally, for the mortality in cases of concussion with subsequent edema is very small; while in cases of brain laceration it is extremely high, and the combined mortality figures depend more upon the preponderance of one group or another than on the efficacy of therapeutic measures.

In the Traumatic Service at the Cumberland Hospital head injuries are subdivided as follows:

GROUP I

Cases of cerebral concussion with no demonstrable brain injury. The mortality in this group is practically nil and most of these cases recover if kept in bed and otherwise let alone. In a variable percentage, however, there is evidence of cerebral edema causing headache, dizziness and transient unconsciousness. In these cases lumbar puncture usually gives a clear fluid but under increased pressure. Repeated lumbar punctures to reduce the pressure to the accepted normal of 10 to 12 mm. of mercury are of distinct value. The pressure should not be reduced at one puncture by more than one-half its elevation above normal. Thus, if the pressure is 20, it should not be reduced during the first puncture to below 15.

GROUP II

Cases of brain laceration and contusion with brain hemorrhage and an increased intracranial tension. The mortality in this group is exceedingly high and most of the cases die within the first twenty-four hours. The cerebrospinal fluid is uniformly bloody in the three tubes and the tension sometimes rises to 60 mm. or higher. The increased intracranial tension in these cases is primarily due to subdural hemorrhage and there is no way of stopping this, unless the source of bleeding can be definitely located; but, there is, in addition to the hemorrhage, interference with the circulation and absorption of cerebrospinal fluid for the following reasons: (1) because of venous engorgement, the intravenous pressure is greater than that of the cerebrospinal fluid and the normal absorption into the veins is upset; (2) there is a loss of absorption area in which the Pacchionian bodies function, owing to, and in direct proportion to the extent of cerebral cortex contused or lacerated; (3) blood effused in the subarachnoid space mechanically impedes the normal flow of the fluid. Rawling states that in consequence of these conditions, there is a damming of the cerebrospinal fluid, generalized brain edema and dilatation of the ventricles.

Authorities opposed to lumbar puncture claim that reduction of intracranial tension removes the tampon action and starts an arrested hemorrhage, and therefore is dangerous. It is doubtful, however, whether hemorrhage can be reestablished once a clot is formed, especially if the reduction is performed gradually. We have followed the accepted rule of reducing cerebrospinal fluid by half the increase above normal. Over 500 cases of head injuries of all groups have been treated and while benefit from cerebrospinal fluid drainage cannot be claimed in this group, no ill effects have been seen resulting from it. In the few cases which survive, the removal of blood from the subarachnoid spaces prevents the formation of adhesions, cysts, etc., which cause late complications. Ochsner and Hosoi[20] are of the opinion that blood in the subarachnoid space is of importance not only because of the danger of cerebral compression, but also because absorption of blood by the Pacchionian granulations causes mechanical blocking, which interferes with the absorption of cerebrospinal fluid.

GROUP III

Comprises cases with focal symptoms, due to a depressed fracture or extradural hemorrhage.

These are operative cases and lumbar puncture is of little therapeutic value except to reduce postoperative cerebral edema.

GROUP IV

Comprises cases which survive the initial shock, but later show symptoms of subtentorial pressure upon the floor of the fourth ventricle where the vagus, vasomotor and respiratory centres are located and where most of the nuclei of the cranial nerves are found. In the early stage, the pulse is slow due to vagus stimulation, the blood pressure rises due to vasomotor stimulation and respiration is slightly accelerated. Later, in the stage of collapse the pulse rate rises, the blood pressure falls and there is Cheyne-Stokes respiration. This is the syndrome described by Von Bergman.

It is doubtful if lumbar puncture is of any value in this group, except as a diagnostic procedure. Jennings[21] has for several years advocated a low bilateral decompression and placing the patient face down with the head lower than the body, the object being to keep the blood in the anterior fossa and to prevent it from trickling into the subtentorial region where it exerts pressure on the brain stem. This procedure is logical and should receive an adequate trial.

SUMMARY

Based on a study of the anatomy and physiology of the brain, and on clinical experiences in a series of over 500 cases of head injuries with study of autopsy material together with a review of the literature on the subject, the following deductions are made:

1. The withdrawal of cerebrospinal fluid by lumbar puncture as a diagnostic procedure should be performed in every case of head injury, after the patient has reacted from shock. The pressure should be recorded and the fluid collected in three tubes about 5 c.c. in each. If the fluid is uniformly bloody in the three tubes, and if the supernatant fluid is xanthocromic after centrifuging, and if the pressure is over 10–12 mm. of mercury, a diagnosis of intracranial injury with probable brain laceration or contusion and hemorrhage can be made.

If the fluid is clear, but under increased pressure, and if there is other corroborating evidence, a diagnosis of traumatic cerebral edema can be made.

If the fluid is clear and the pressure is normal, one is justified in ruling out an intracranial injury even in the presence of a fractured skull.

2. Lumbar puncture is a useful therapeutic procedure in cases of traumatic edema. The pressure should be reduced by half the excess above normal, and the procedure repeated about every six to twelve hours until the pressure is normal.

3. When the fluid is bloody and under increased pressure, no ill effects have been noted from repeated punctures, if the pressure is not reduced suddenly.

4. Adoption of a uniform method of classifying head injuries will help to eliminate the confusion and conflicting opinions which now exist regarding diagnostic and therapeutic procedures and will render our statistics, especially regarding mortality, more reliable.

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PULMONARY EMBOLISM*

BASED UPON A STUDY OF 271 INSTANCES

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PULMONARY embolism is still the gravest complication that may occur during convalescence. Despite marked advances made in the past decade in diminishing the occurrence of other grave factors in hospital morbidity, the incidence of pulmonary embolism has steadily increased. It is now imperative that further study be undertaken to determine what measures can be directed towards the lessening of both its incidence and high mortality.

Numerous valuable contributions have been made to the various phases of this subject in the past, which have been of outstanding value and have largely determined the present conceptions. For purposes of brevity these contributions will not be reviewed, but the appended bibliography will furnish references to their original work.

In Chart I is tabulated the incidence of pulmonary embolism as reported in the literature during the past twenty-four years by fifteen authors. In 316,060 cases this incidence was determined to be 0.52 per cent. In Chart II is presented the data derived from studying 34 instances of pulmonary embolism, 0.068 per cent, that occurred in 47,338 admissions during the eight year period from January, 1928, to January, 1935, at the Hollywood Clara-Barton Memorial Hospital. In Chart III are summarized the facts obtained from the records of 227 examples of pulmonary embolism, or 2.07 per cent, from 10,940 consecutive unselected postmortem records of the Los Angeles County General Hospital. In Chart IV are depicted the results of treating 10 patients with pulmonary embolism following various operations by the proprietary drug, "spasmalgin" (Hoffmann-La Roche, Inc.). A brief summary of the three classes of material in Charts II, III and IV is presented in Chart V.

Previous studies by various authors have established the following facts concerning the etiology and the prevention of pulmonary embolism.

1. Some of the predisposing factors in the causation of pulmonary embolism are:—an incision into the anterior abdominal wall; varicose veins in the lower extremities; obesity; advanced age; wound infections; trauma, usually in the form of comminuted fractures of the bones of the lower extremities; failure to properly immobilize fractures; hypotension; orthopedic operations; inadequate hemostasis in an incision allowing hematoma formation to occur; the use of fat solvents in cleansing incisions preparatory to closure; injection treatment of varicose veins of the lower extremities; diminution of intestinal peristalsis; stagnation of the venous return from the tributaries of the inferior vena cava; gouty or anemic individuals; puerperal thrombosis of the pelvic or femoral veins; influenza; getting up too soon following an operation; faulty surgical technique; injury to vascular walls by either trauma or infection; the common marked increase of the prothrombin and coagulation time, and the increased number of blood platelets and leucocytes immediately following surgery; endocarditis and myocarditis of the right side of the heart, etc.

* Presented in abstract form before the regular meeting of the Staff of the Hollywood Clara-Barton Memorial Hospital, January 28, 1936.

2. The occurrence of pulmonary embolism may be often prevented by the following methods:—performance of exact atraumatic surgery with absolute hemostasis; minimizing intestinal paresis postoperatively; avoidance of unnecessary or extensive surgery in the aged, gouty, anemic or obese patient; prompt splinting of all fractures at the site of the accident before moving the individual; the use of a tourniquet on extremities proximal to the site of an orthopedic operation; avoidance of too tightly constricting abdominal surgical dressings; rigid asepsis to prevent wound infections; prompt and thorough drainage of infected wounds; passive and active moving of the lower extremities; prohibition of pillows under the knees; heat to the lower extremities and to the trunk; avoidance of postoperative pulmonary complications; the use of thyroid extract until ambulatory in all cases where no contraindication exists; determining if your patient is "thyroxine-resistant" according to the method advocated by Bankoff and the postoperative administration of "ephetonin" and atropine sulfate if he is; the routine postoperative treatment of all surgical patients by "sympatol," as recently so successfully reported by Fraundorfer; the employment of "pitressin" to maintain intestinal tonus and to prevent postoperative ileus; and the use of "calcium-gluconate" pre- and postoperatively.

CHART I

INCIDENCE OF PULMONARY EMBOLISM AS REPORTED IN THE LITERATURE

Year	Author	Number of Cases Studied		Number of Instances of Pulmonary Embolism		Incidence Per Cent of Pulmonary Embolism	
		Surgical	Autopsy	Surgical	Autopsy	Surgical	Autopsy
1912	Wilson	11,453	.....	36	...	0.31	
1923	Heard	63,573	.....	151	...	0.237	
1923	Kümmel	2,265	.....	34	...	1.5	
1924	Lockhart-Mummery	42,294	.....	35	...	0.08	
1925	de Quervain	76,799	.....	211	...	0.28	
1925	Naegli	15,343	4,916	21	43	0.14	0.87
1927	Henderson	63,247	.....	267	...	0.42	
1928	Hoering	.....	3,248	...	131	....	4.03
1928	Martini	.....	3,193	...	90	....	2.81
1930	Walters	4,500	.....	4	...	0.09	
1930	Petren	3,363	.....	26	...	0.77	
1923	Hosoi	.....	810	...	64	....	7.90
1935	Schmidt	.....	335	...	53	....	15.82
1935	McCartney	.....	9,781	...	283	....	2.89
1936	Los Angeles County General Hospital	.....	10,940	...	227	....	2.08
Totals		282,837	33,223	785	891	0.28	2.68
Grand Totals		316,060		1,676		0.53	

The newest concept concerning pulmonary embolism was presented by Gosset, Bertrand and Patel in 1932, by experimental studies finding that an embolus was fixed at its point of lodgement by arterial spasm. Prior to this time it had been believed that an embolus mechanically plugged a vessel and that its size and the diameter of the arterial lumen solely determined the point of ultimate lodgement of the embolus. Their work promptly led to a search for substances that were immediate arterial antispasmodics. This reinitiated the experimental use of papaverine as of possible value in this regard, advocated by Pal in 1914 and Macht in 1916.

CHART II

PULMONARY EMBOLISM, HOLLYWOOD CLARA-BARTON MEMORIAL HOSPITAL; JAN. 1928–JAN. 1935

Incidence		
34 cases in 47,338 total admissions	0.072 per cent	
24 cases in 16,984 major surgical operations	0.14 per cent	
Sex		
Males	9	
Females	25	
Mortality		
Fatal cases	18	
Non-fatal cases	16	
Surgical cases		24
Hysterectomy, etc	4	
Cesarian section, sterilization, etc	2	
Suprapubic prostatectomy	3	
Exploration for bowel obstruction	3	
Fracture of femur, manipulation, cast, etc	2	
Cholecystectomy for cholelithiasis	2	
Radical amputation of breast, carcinoma	1	
Salpingo-oöphorectomy, appendectomy	1	
hemorrhoidectomy, acutely strangulated	1	
Fulguration, bladder carcinoma	1	
Large ventral hernioplasty	1	
Left pelviolithotomy	1	
Appendectomy, interval chronic case	1	
Interposition operation for cystocele	1	
Non-surgical cases		10
Endocarditis, myocarditis, right heart	2	
Fractured ribs, etc	3	
Pregnancy	3	
Fractured mandible and cervical vertebra	1	
Chronic nephritis and cholecystitis	1	
Traumatic pulmonary embolism (all fractures)		7
Ribs	2	
Elbow in 2 places and ribs	1	
Neck of right femur	2	
Both tibias, fibulas and right pubis	1	
Mandible and cervical vertebra	1	
Origin of thrombus		17
Veins of left lower extremity	6	
Veins of right lower extremity	4	
Pelvic veins, postpartum	4	
Left ovarian veins	1	
Right auricle	1	
Right ventricle	1	
Source of origin of embolus unknown		17
Lung involvement		
Right middle lobe	1	
Right lower lobe (1 lung abscess)	13	
Left lower lobe	6	
Lower lobes of both lungs	9	
Not stated	5	
Nutrition of the patient		
Obese		18
Not obese		10
Not stated		6
How diagnosis was confirmed		
Postmortem		7
Roentgenogram of chest		12
By clinical signs and symptoms		15
Fever		
Fever before onset of embolism		18
Infected incision		
Infected incision		9
Non-infected incision		13
Not stated		2
Associated cerebral embolism		2
Number of separate embolisms		34
One	27	
Two	4	
Three	3	

AGE

Years	Males	Females
0–10	0	0
10–20	0	0
20–30	2	7
30–40	0	3
40–50	3	4
50–60	2	5
60–70	1	3
70–80	1	3
	9	25

Postoperative day of onset of pulmonary embolism (of most severe symptoms)

Day	No. Cases
1	2
2	4
3	0
4	2
5	2
6	2
7	1
8	2
9	2
10	1
11	4
12	1
13	2
14	2
15	1
16	3
17	1
26	1
29	1
	34

Time after onset of pulmonary embolism until death

Minutes	
0–15	0
15–30	4
30–45	1
45–60	2
Hours	
1– 2	6
2– 4	1
4– 6	1
6– 8	1
8–12	0
12–24	2
	18

CHART II (*Continued*)

Number of days spent in the hospital (non-fatal cases)	
0– 10	0
10– 15	1
15– 20	1
20– 25	4
25– 30	2
30– 35	4
60– 65	1
85– 90	2
110–115	1
	16

Month of occurrence of embolism	
January	5
February	4
March	2
April	2
May	2
June	3
July	1
August	2
September	3
October	3
November	3
December	4
	34

Denk in 1934 was the first to treat clinically 10 patients suffering from various types of arterial embolism by the intravenous use of papaverine. Six of his cases fully recovered. It was his belief that the results from this mode of medication were as good as those derived from surgical embolectomy. He was also the first to suggest the possible use of papaverine in instances of pulmonary embolism. In 1935 Allen and MacLean successfully used this drug in one instance of sudden arterial occlusion. They said, "Finally, we suggest that treatment with papaverine be tried in cases of occlusion of the coronary, cerebral, mesenteric and pulmonary arteries." De Takáts reported in 1935 and 1936 the successful treatment of one instance of pulmonary embolism and 4 cases of arterial occlusions by the use of papaverine. McKechnie and Allen in 1935, studied 100 cases of embolism and thrombosis. They concluded,

Vasodilators should be given to relieve arterial spasm, if present. Papaverine hydrochloride, which is a vasodilator when given intravenously in amounts of one-half grain (0.032 gm.), will produce immediate improve-

CHART III

DATA DERIVED FROM LOS ANGELES COUNTY GENERAL HOSPITAL, DEPARTMENT OF PATHOLOGY

(227 cases of fatal pulmonary embolism in 10,940 postmortem examinations, or 2.07 per cent)

Summary of Data		Number Cases	Per Cent
Sex			
Males		91	40.1
Females		136	59.9
Surgical cases		142	62.5
Non-surgical cases		85	37.5
Traumatic pulmonary embolism		23	10.1
Origin of embolus			
Veins of lower extremities		116	51.1
Left side	99		
Right side	17		
Veins of pelvis		24	10.6
Miscellaneous veins		9	3.9
Right side of heart		47	20.7
Not stated		31	13.7
Lung involvement			
Right lung		92	40.5
Upper lobe	7		
Middle lobe	20		
Lower lobe	65		
Left lung		74	32.6
Upper lobe	11		
Lower lobe	63		
Both lungs		61	26.9
Upper lobes only	0		
Upper and one lower lobe	13		
Both lower lobes	31		
Both lower lobes and right middle lobe	11		
Right middle lobe and one lower lobe	6		
Nutrition of patient			
Obese		149	65.6
Not obese		51	22.9
Not stated		27	11.5

AGE

Years	Males	Females
0–10	0	0
10–20	1	5
20–30	11	23
30–40	18	21
40–50	23	31
50–60	18	30
60–70	14	17
70–80	3	7
80–	3	2
Totals	91	136

CHART III (*Continued*)

Occurrence according to month	
January	16
February	13
March	19
April	22
May	24
June	20
July	11
August	9
September	22
October	18
November	24
December	29
Totals	227

ment in the circulation of the limb within a few minutes if it is effective at all . . . Care should be taken that the solution of papaverine is physiologically active. If the first injection does not cause immediate improvement, it is questionable that further trial with this drug will benefit the circulation.

With this data as a background, I have been using papaverine hydrochlorid intravenously in instances of postoperative pulmonary embolism in an effort to prevent an otherwise usual fatal outcome. A briefly

CHART IV

SUMMARY OF PATIENTS TREATED WITH "SPASMALGIN" WHO HAD PULMONARY EMBOLISM

Case	Sex	Age	Probable Source of Embolus	Post-operative Day of Onset	Days Spent in Hospital	Type of Operation	Complications	Final Result
1	M	33	Right femoral vein	12, 13	43	Hernioplasty	Left bronchopneumonia	Well
2	M	73	Left femoral vein	13	61	Reduction fracture, right femur	Empyema, lower lobe, right lung	Well
3	F	65	Left iliac vein	9, 13	37	Wertheim radical hysterectomy for carcinoma	Right bronchopneumonia	Well
4	F	59	Left internal iliac vein	11, 12	71	Cholecystectomy	Bilateral bronchopneumonia, bacteriemia	Died
5	M	56	Left internal iliac vein	12	36	Suprapubic cystostomy	Left bronchopneumonia	Well
6	F	71	Left femoral vein	10, 12	59	Fulguration, carcinoma of bladder	Left bronchopneumonia	Well
7	M	49	Left external iliac vein	14	47	Pyloroplasty, chronic duodenal ulcer	Left bronchopneumonia	Well
8	F	60	Right internal iliac vein	17	31	Abdominal hysterectomy, fibroid uterus	Lung abscess, lower lobe, right lung	Well
9	F	57	Left external iliac vein	11	83	Colostomy, carcinoma of sigmoid	Left bronchopneumonia	Well
10	F	39	Left ovarian vein	10, 14, 16	35	Abdominal panhysterectomy, fibroids, twisted left ovarian cyst	Bilateral bronchopneumonia	Well

SUMMARY

Sex: males, 4; females, 6.
Average age, 56.2 years.
Average day of onset following operation, 12.6 days.
Average stay in the hospital, 50.3 days.
Obese patients, 6.
Mortality, 10.0 per cent.
Infected incisions, 6.
Hematoma formation in the incision, 4.
Traumatic pulmonary embolism, 1.
Fever before the onset of the embolism, 4.

Complications	
Bronchopneumonia	10
Right lung	3
Left lung	4
Both lungs	3
Empyema	1
Lung abscess	1
Bacteremia	1
Number of episodes of embolism	
Single	5
Two	4
Three	1

reported case history of my most recent instance of this complication follows:

A white female, widow, aged thirty-nine years, five feet two and one-half inches tall, weighing one hundred fifty-five pounds, recently presented herself with complaints referable to her pelvis. Pelvic examination revealed an enlarged tender cystic left ovary and a moderately enlarged retroverted fibromyomatous uterus. The rest of the physical exami-

CHART V

SUMMARY OF DATA OF 271 INSTANCES OF PULMONARY EMBOLISM

Sources of Material

Where Derived	Type of Material	Number of Cases	Number of Pulmonary Emboli	Incidence Per Cent of Pulmonary Emboli
Hollywood Clara-Barton Memorial Hospital	Medical and surgical	47,338	34	0.072
Los Angeles County General Hospital	Postmortem	10,940	227	2.07
Cases personally observed in past ten years	Surgical	6,240	10	0.45
Totals		64,518	271	0.44
Sex				
Males			104	38.4
Females			167	61.6
Surgical cases			176	64.9
Non-surgical cases			95	35.1
Traumatic pulmonary embolism			31	11.4
Origin of thrombus				
Veins of lower extremity			133	49.1
Veins of left lower extremity			110	
Veins of right lower extremity			23	
Right side of heart			49	18.1
Pelvic veins			30	11.1
Miscellaneous veins			9	3.3
Not stated			48	17.7
Lung involvement				
Right lung				
Upper lobe			7	
Middle lobe			21	
Lower lobe			81	
			109	40.2
Left lung				
Upper lobe			11	
Lower lobe			74	
			85	31.4
Both lungs				
One upper and one lower lobe			13	
Both lower lobes			42	
Both lower lobes, right middle lobe			11	
One lower lobe, right middle lobe			6	
			72	26.6
Not stated			5	1.8
Totals			271	
Nutrition of patient				
Obese			173	63.8
Not obese			65	24.0
Not stated			33	12.2

CHART V (*Continued*)
AGE

Years	Males	Females
0–10	0	0
10–20	1	5
20–30	13	30
30–40	19	25
40–50	27	35
50–60	21	37
60–70	15	22
70–80	5	11
80–	3	2
	104	167

Occurrence according to month

January	22
February	17
March	22
April	25
May	27
June	23
July	13
August	11
September	27
October	21
November	29
Totals	271

nation was essentially negative. The blood pressure was 122/70. All of the laboratory examinations were within normal limits.

Several days later an abdominal panhysterectomy was performed without incident for fibromyomata uteri, chronic metritis and perimetritis, chronic endocervicitis, chronic bilateral salpingo-oöphoritis, cystic left ovary with a twisted pedicle and large varicosities in the left broad ligament.

The patient had an uneventful convalescence until the tenth postoperative day, when at 7:30 A.M. she experienced a sudden pleuritic pain at the base of the right lung. There was no objective evidence as to the source of this embolus. Clinical and roentgenological evidence supported the diagnosis of a pulmonary infarct present at the base of the right lung. As a precautionary measure, a sterile hypodermic syringe was loaded with a 1 c.c. ampoule of spasmalgin which preparation contains papaverine hydrochloride 0.021 gm.; pantopon 0.012 gm.; and "Atrinol" 0.001 gm. It has been found valuable to add an opiate to control the severe precordial pain that these patients experience and a slower acting antispasmodic in the form of atropine to protract the arterial antispasmodic action as long as possible.

Despite strict quiet, another small embolism occurred on the fourteenth postoperative day involving the base of the left lung, manifested by "prune-juice" sputum, moderate bilateral pleurisy, dyspnea and precordial distress. Immediately following a light luncheon on the sixteenth postoperative day, the patient had a massive embolism followed by immediate complete collapse and semicoma. "Spasmalgin," 1 c.c., was administered intravenously within three minutes following the onset of symptoms and she promptly recovered. Signs and symptoms referable to the extreme degree of arterial dilatation persisted for five hours. Subsequent chest roentgenograms revealed a massive pulmonary infarction of the lower lobe of the left lung. On the thirtieth postoperative day the temperature was again normal and the patient was dismissed from the hospital on her thirty-fifth postoperative day. At home she has made a steady but slow convalescence so that now, ninety-seven days following surgery, she is again able to do most of her ordinary household duties without discomfort. Her chief complaint has always been referable to the base of the left lung where the massive pulmonary infarction occurred and has been characterized by severe intermittent pleuritic pains and pseudo-angina pectoris symptoms caused by the extensive damage of the left dome of the diaphragm and the visceral pleura of the lower lobe of the left lung. Porter recently referred to similar experiences with pseudo-anginal pains due to a diaphragmatic flutter. In this patient the source of the pulmonary embolus was believed to have originated from a thrombosis of the remaining portions of the large varicosities in the left broad ligament, although a particular effort had been made at the operation to completely remove these. At no time was any edema detectable in either lower extremity.

This case report constitutes the tenth case that I have treated personally in a similar manner; 9 of these patients are alive and well today, having recovered without additional methods of treatment.

However, if this method fails to relieve the patient promptly, he should be immediately taken to surgery and the classical Trendelenburg pulmonary arterial embolectomy performed without delay. At the end of that operation, a low midline abdominal incision should be made and the

inferior vena cava should be purposely ligated just cephalad to its formation by the union of the two common iliac veins, to prevent the possible subsequent repetition of a massive pulmonary embolism. Pulmonary emboli usually originate from the veins of the lower extremities and the pelvis. In 1934, Wakefield and Mayo, Walters and Priestley, and Pfaff have shown that the ligation of the inferior vena cava caudad to the renal veins is usually not a particularly dangerous proceedure to either the life or the future usefulness of the patient. Many of the failures of the Trendelenburg operations in the past have been attributable to the subsequent postoperative liberation of new extensive pulmonary emboli that caused death needlessly in an otherwise brilliant operative result.

DISCUSSION

Obesity plays an important role in pulmonary embolism, 63.8 per cent of this series were classed as being definitely obese; 64.9 per cent had recent surgical procedures, 94.3 per cent of which had been abdominal operations. Of this group there were 61.5 per cent females, which agrees with the findings of Heard, Henderson, and others. There were 11.4 per cent of the instances judged as being caused by trauma, which is lower than the figure of 21.6 per cent as given by McCartney and 49.1 per cent of cases originated from thromboses in the veins of the lower extremities and another 11.1 per cent originated from veins in the pelvis; thus totaling 60 per cent of instances that originated from thrombotic veins caudad to the formation of the inferior vena cava. However, if the surgical patients alone are studied, this figure increases to 92.3 per cent. Thus, again, the rationale of ligation of the distal portion of the inferior vena cava well caudad to the renal veins is immediately apparent following the performance of a Trendelenburg operation, so as to guarantee the permanency of the original operative result. There were 18.2 per cent of examples originating from thrombotic processes present in the right side of the heart.

A decrease in the incidence of pulmonary embolism seemed to be apparent during the Summer months, while the greatest number occurred during the Fall and Spring months.

Of these patients 65.7 per cent were over the age of forty years and 42.8 per cent were more than fifty years of age.

Thus, this study has reemphasized the importance of obesity, advanced age, abdominal surgery, female sex, trauma, and the Spring and Fall seasons of the year as being important causative factors in pulmonary embolism, besides thromboses of the veins of the pelvis and lower extremities. The results obtained from this study compare favorably with those previously reported in the literature upon this subject.

CONCLUSION

1. A summary of 271 instances of pulmonary embolism are reported from both clinical and postmortem sources. Its incidence in 316,060 patients studied in the past in the literature was determined to be 0.53 per cent.

2. Obesity, advanced age, infections, abdominal surgery, female sex, trauma and venous thromboses in either the lower extremities or the pelvis are important contributing etiological factors in the causation of pulmonary embolism.

3. Preventative measures include aseptic atraumatic surgery, absolute hemostasis, avoidance of unnecessary surgery in the aged or obese patient, elimination of factors causing fat embolism, prompt drainage of infected wounds, heat to and early unrestricted moving of the lower extremities, thyroid extract by mouth, minimizing intestinal paresis, and the avoidance of pulmonary complications.

4. A case report is included in which a massive and obviously fatal pulmonary embolism was successfully treated medically by the intravenous administration of papaverine in the form of "spasmalgin" (Hoffman-La Roche).

5. Nine other cases have been similarly treated in the past with one death from a complicating bacteriemia.

6. It is suggested that in the future, if a Trendelenburg pulmonary arterial embolectomy is necessary, that the distal portion of the inferior vena cava, well caudad to the renal veins, be ligated so as to prevent the possible occurrence of a subsequent fatal pulmonary embolism.

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CLEAN WOUND SURGERY IN HOT CLIMATES*

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OUR interest in the healing of clean operative wounds was stimulated by the appearance of several articles in the literature on this subject. Our impression was that clean wound infection was rare in hot countries although serum collections occurred in some operative wounds on our surgical service but there were no severe infections or epidemics of wound infections. Whipple[1] defined primary wound healing as the restitution of the incised tissues to their normal condition with the least possible scar and with no discharge of, or any exudate from, the line of incision or from any stitch holes, which either clinically or bacteriologically indicates infection. According to this definition we were having postoperative wound infections.

Believing this to be true we investigated the bacteriology of wounds and common infections found in this subtropical climate, also comparing the results obtained in wounds repaired with silk and catgut.

McDill[2] said that good surgery, like gold, is wherever one finds it and is not modified in any way by climate. This is true in regard to controllable factors such as sterilization of supplies, instruments, linen, gloves and everything that comes in contact with the operative field. Clean wound surgery is modified by climate in some uncontrollable aspects such as the bacterial flora found in hot climates.

Whereas pyogenic infections are very common in warm, moist lands, surgeons have observed repeatedly that streptococcal infections and diseases known to be caused by streptococci are uncommon. Conner[3] observed that the staphylococcus is more to blame in the tropics for infections than the streptococcus; that natives seem to possess some natural immunity against streptococcal infections. McDill[2] wrote that if there is any peculiarity about microbic wound infections in the tropics, it is probably that the streptococcus is so rarely encountered in wounds compared to its prevalence in temperate zones. Faul[4] observed that in Ceylon, streptococci infections were very unusual. Barry[5] reported that streptococci were rare in Burma.

In tabulating 276 pyogenic cultures obtained from all sources, except nose and throat cultures, during the past three years, hemolytic staphylococci were found in 245 or 88 per cent, and 15 cultures a nonhemolytic or faintly hemolytic streptococcus was grown. None of the patients from which streptococci were grown were clinically seriously ill. In the clinical hospital records during the past ten years not a single case was found of severe hand infection due to a streptococcus such as is usually present in the surgical wards in the United States hospitals. This fulminating and often tragic disease is unknown here. One likewise never sees a phagedenic ulceration of the skin due to anaerobic streptococcus.

In considering air contamination of wounds Pomales[6] and Morales-Otero[7] have both demonstrated that in Puerto Rico, the Streptococcus viridans is the predominating organism in normal throats. In a series of 100 persons studied by Pomales[6] hemolytic streptococci were found in normal throats in 17 per cent, 3 being of the beta-hemolytic type. Morales-Otero[7] in a study of the virulence of beta-hemolytic streptococci in normal throats found the virulence usually very low. Recently, Pomales[6] and Morales-Otero[9] have completed a study of the biology of beta-hemolytic streptococci isolated in Puerto Rico from various conditions. Thus far they have been unable to detect any appreciable difference

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between hemolytic streptococci isolated here and those isolated in the United States, except for an apparent attenuation in the virulence of their strains when taken as a group.

Meleney[10] has called attention to the relationship of hemolytic streptococci carriers among the operating personnel to postoperative wound infections. On our surgical service masks were worn only over the mouth because of the heat and the fogging of glasses, yet an epidemic of postoperative wound infections has never occurred in this hospital.

In summarizing these mentioned considerations on bacteriology in tropical climates, the conclusion is inescapable that streptococcus wound infections are uncommon. Clinical and bacteriological evidence points to the low virulence of the streptococcus group.

It has been said that every surgical operation is an experiment in bacteriology. Whereas there are no severe wound infections, the ordinary hemolytic staphylococci infections are unusually common. Moist skin, exposed under laboratory conditions of heat and moisture, provides an ideal culture media for staphylococci. This ubiquitous, vicious hemolytic staphylococcus so frequently encountered in common infections, is the usual offending organism in clean wound surgery in hot climates. For this reason special attention to skin preparation is stressed. On our service a "sterile" preparation is done twenty-four hours before operation using benzene or ether, green soap applied with a brush and alcohol. Immediately before operation the usual iodine-alcohol preparation is used.

Kocher, Halsted and Whipple have shown the advantages of buried silk in the repair of clean wounds. If the advice of most authors of works on tropical surgery is to be followed buried silk as a suture material should not be used. We believe that by using silk only in the repair of clean wounds, better wound healing is obtained. Under tropical conditions surgery is certainly favored in this respect by the infrequency of serious infections.

We have followed 60 hernia cases in which silk only was used in 27 and catgut in the remaining 33, and 30 miscellaneous cases sutured with silk, observing particularly the wound healing. In most instances the silk repaired wounds healed with less reaction as evidenced by induration, redness, hematoma, serum collection or infection.

Table 1

	Total	Clean	Per Cent	Infection	Per Cent	Induration	Per Cent	Serum	Per Cent	Hematoma	Per Cent
Hernias, using all silk technique	27	26	96	1	4	0	0	0	0	0	0
Hernias, using catgut	33	25	76	1	3	3	9	4	12	0	0
Miscellaneous, using all silk technique	29	27	93	0	0	1	3	1	3	0	0

The 60 patients with hernia were selected at random regardless of age, sex, duration of symptoms, type or location of the hernia and included inguinal, femoral and ventral hernias. The operative procedure varied somewhat in detail but in this review is not important. The same pre- and postoperative care was given in call cases.

Table 1 shows the comparison of catgut and silk technique in all cases.

In this small series of cases the comparison favors the use of silk with a higher percentage of clean wounds in which silk alone was used. The 2 infections in the whole series were caused by hemolytic staphylococcus aureus but there were more wounds with induration and serum collec-

tions in the cases repaired with catgut. The temperature elevations postoperatively averaged the same in both the silk and catgut series. The hospital stay was the same in all hernias since this type of case is routinely hospitalized eighteen to twenty-one days, which has proved a wise measure because of the poor home conditions.

A follow-up study was attempted on the patients with hernia. It is recognized that a report of one to three years on presence or absence of recurrence is of no value as to permanent cure. It may be an indication of the tensile strength of the wounds, however, since most of the patients were forced into work by economic pressure shortly after discharge from the hospital. Of the 33 cases repaired with catgut 15 were satisfactory, 5 had recurred and 13 did not reply. Of the 27 all silk cases 18 were satisfactory to date, 3 had recurred and 6 gave no answer. These figures tend to lend support to the superior strength of silk repaired wounds. However, in the question of recurrence many other factors must be considered.

The group of miscellaneous cases repaired with all silk technique included 13 operations on fractures and bones, 8 thyroidectomies, 4 splenectomies, 2 radical breast amputations, etc. The average hospital stay was nine days. There were no infections.

Faulty technique and not the use of silk was blamed for the one case each of induration and serum which occurred in 2 thyroidectomies.

From this series of cases we concluded that wounds repaired with silk showed less reaction, as evidenced by induration, redness, serum collection, hematoma and infection. We believe that the use of silk in the repair of clean wounds has a definite place in hot climates. If silk is to be used it is important to avoid the errors enumerated by Whipple, (1) tight sutures, (2) mass ligatures, (3) blunt scissors dissection, (4) careless hemostasis, (5) only finest grades of silk, (6) combining silk and catgut, (7) the use of silk in any but a sterile field and (8) continuous sutures.

CONCLUSIONS

1. There is definite evidence that in the tropics hemolytic streptococcus wound infections are uncommon and mild.

2. Fifty-six operative wounds repaired with all silk technique are reported and 33 cases repaired with catgut are included as controls.

3. The use of silk in the repair of clean wounds is advocated providing the surgeon observes the rules issued by Halsted and later by Whipple.

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COMPOUND COLORED ALCOHOLIC SOLUTION OF MERCURIC CHLORIDE FOR SKIN DISINFECTION*

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MUCH has been written concerning the relative merits of antiseptics, but most of this work has been in vitro. When Vaichulis and Arnold reported their new solution, it was compared clinically with some of the other solutions used.

Lacerated wounds of various parts of the body were used to study the clinical value of these antiseptics. The wound was scrubbed with green soap and water, all debris removed and then painted with the antiseptic in question; then draped and sutured under aseptic conditions, threading the needle by means of forceps. No gloves were worn, however.

We have used 800 sutured wounds for this study, divided equally among the standard alcoholic solutions of iodine, merthiolate, mercurochrome and compound colored alcoholic solution of mercuric chloride. For convenience we call this solution C.A.S. (compound alcoholic solution).

The personal equation in treating these wounds is fairly well eliminated as the wounds were tended by 33 individuals, all of whom had been taught the same method of treatment. All of these wounds were potentially infected when first seen.

The percentages of infections with the various solutions used are

	Per Cent
Iodine	9.2
Mercurochrome	14.0
Merthiolate	12.5
C.A.S.	5.5

The formula of Vaichulis and Arnold† for compound colored alcoholic solution of mercuric chloride is as follows:

Ethyl alcohol (95 per cent)	600 c.c.
Acetone (U.S.P.)	200 c.c.
Mercuric chloride	1 gm.
Hydrochloric acid (conc.)	10 c.c.
Chrysoidin Y	2 gms.
Water up to	1000 c.c.

To make these figures more informative we have considered these wounds under the following headings, scalp, forehead, face, forearm, hand, fingers, lower extremity and body. Each heading is subdivided into sharp and contuse wounds. A wound produced by a knife, glass or sharp edge is a sharp wound; one produced by a blunt object or a fall against a semi-sharp object is contused although the resulting wound may appear sharp in its nature.

Our percentages of infection varied but slightly in the sharp and contused wounds, except in the iodine group.

	C.A.S., Per Cent	Iodine, Per Cent	Mercurochrome, Per Cent	Merthiolate, Per Cent
Sharp	8.1	6.3	14	11
Contused	8.4	12.0	14	14

The table on page 224 shows the number of cases treated in each group and the percentage of infection with each of the antiseptics used.

In further studying these figures we find that the seasonal incidence of infection can be neglected as the periods covered by each

Iodine	January to September
Mercurochrome	February to December
Merthiolate	June to December
C.A.S.	October to April

group overlap. There appears to be no relationship between the percentages of

† VAICHULIS, JOHN A. and ARNOLD, LLOYD. Compound colored alcoholic solution of mercuric chloride for skin disinfection. *Surg., Gynec. and Obst.*, 61: 3, Sept. 1935.

* From the Out Patient Surgical Service of the Norwegian Hospital, Brooklyn, N. Y.

infections for each man and the season of the year.

We have used this compound colored alcoholic solution of mercuric chloride for open wound but not more so than any other alcoholic solution. It produces no irritation in open wounds nor does it interfere with the normal healing.

	No. of Cases	C.A.S.	Iodine		Merthiolate		Mercurochrome	
		Per Cent Infected	Cases	Per Cent Infected	Cases	Per Cent Infected	Cases	Per Cent Infected
Scalp	43	2.3	39	7.6	25	0	31	12.0
Forehead	28	7.1	18	5.5	20	0	21	4.7
Face	52	5.7	56	5.3	36	22	43	13.0
Forearm	10	10.0	25	16.0	20	15	29	10.0
Finger	32	6.2	33	6.0	37	8.1	28	21.0
Hand	21	4.7	14	14.0	31	12	28	17.0
Lower extremity	10	10.0	10	30.0	30	23	16	18.0
Body	4	0	5	0	1	0	4	0

repeated aspirations of bursa, removal of foreign bodies, etc. At no time did an infection develop. The solution is non-irritating and can be reapplied daily without fear of irritation or burning. The color is lasting when protected by a bandage, but may be washed off readily with water or alcohol where so desired. The solution burns considerably when put into an

This solution can be prepared at a fraction of the cost of the others considered.

SUMMARY

Four alcoholic antiseptic solutions have been compared under similar conditions. The compound colored alcoholic solution of mercuric chloride has been found to be a more efficient antiseptic than the other three and much more economical.

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* *Continued from p. 209.*

GRUSKIN INTRADERMAL TEST FOR PREGNANCY*

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IN a recent publication Gruskin[1] presented a placental antigen for the intradermal determination of pregnancy. The simplicity of the test, as a rapid means of diagnosis, stimulated investigation to determine its value and a series of cases are hereby reported.

Sir Thomas Lewis[2] in his monograph on "The Blood Vessels of the Human Skin and Their Responses" believed that a histamine-like substance, the H-substance, is responsible for the reactions of all irritating substances coming in contact with the skin. When a chemical, mechanical, electrical or thermal stimulus is brought in contact with the skin, it produces a triple response; a "local dilatation of the minute blood vessels, an increased permeability of their walls, and a widespread arteriolar dilatation with a final formation of a wheal."

Lewis did little work however with allergic extracts but Ronald Hare[3] studied protein sensitive patients and confirmed Lewis's assumptions. Harris[4] found that the active H-substance is present in much greater concentration in the superficial or epithelial layer of the skin than in the deeper layers.

According to Coca, Walzer, and Thommen,[5] the most important mechanical factor influencing wheal formation is the state of circulation of the tissues. Diseases and circulatory disturbances which diminish or increase the rapidity of the blood flow alter wheal formation. It is diminished in edema, cretinism, myxedema and cardiac decompensation with edema but is normal in valvular heart disease and nephritis in which the circulation is efficient. Marked dehydration lessens wheal formation. Diminished whealing may be manifested in cases where the skin has been recently injured, as with *x*-ray, radium or sunburn. A diminished skin reaction occurs following skin tests rapidly repeated with the same atopen on the same skin site. R. A. Cooke[6] demonstrated the phenomenon to be the result of a non-specific exhaustion of the tissues, the state to which the term "refractoriness" has been applied by Lewis. According to Lewis an exaggerated dermographic response is found in some normal individuals. In cases of urticaria it is decidedly more pronounced and is exaggerated in a larger percentage of atopic individuals than normals. There will also be variations in the degree of tissue response in the skin from the mechanical trauma inflicted in the performance of the test. In performing skin tests one should select areas of normal skin. With the intracutaneous technique, the test solution must not be injected too superficially, but if the solution is injected too deeply, the reaction is partly hidden by the superimposed tissue and the wheal may lose its sharp outline. Some increase in the size of the intradermal wheal always occurs in some normal individuals. It differs completely in appearance from that produced by a substance to which sensitization is present. Thus instead of raising and distending the outer layers of the epidermis, so that it stands out clear cut against the rest of the skin, it infiltrates the outer layers in a "passive" rather than an active manner. This passive whealing may depend upon the nature of the skin. Wheals also occur readily as a result of a so-called "splash" reaction. This splash effect seems to occur with particular readi-

* From the Allergic division of the Department of Medicine, Long Island College Hospital. This paper was made possible through the cooperation of the Obstetrical and Gynecological Department of this institution.

ness with some individuals, possibly due to the loose texture of their skins or may be caused by air bubbles in the syringe. In these the top layer separates easily, like a thin web, from the underlying integument. Introduction of the solution causes a cleavage between these two layers and a dispersion of the fluid, either in angular lines, or diffusely in all directions. In such cases, it is necessary to introduce the fluid a trifle deeper. Although dermographism is present to a marked degree in some individuals, its presence is rarely elicited by a carefully given intradermal injection where the needle is sharp and the fluid is injected slowly. The trauma here is minimal. Injection of the solution very slowly prevents false pseudopod formation due to injury of the skin. If the reactions are dermographic, injections of normal saline should produce a similar response. The importance of using a control solution of not only saline but also one comparable in nitrogen content and the same *p*H as the testing solution cannot be over-estimated. It is also possible for skins of normal individuals to have a general non-specific protein sensitization without dermographism. A thorough knowledge of the fundamentals of wheal formation is therefore essential to any one who expects to employ skin testing extensively.

Only when it is known that all non-specific causes of positive skin reactions in an individual can be excluded and that the test would be negative in normal individuals, does the reaction attain significance. Having once excluded the non-specificity of the antigen, the hypersensitivity of the skin or improper technique one is justified in assuming that he is dealing with an allergic response of the skin, if the reaction is positive and then the clinical significance of the reaction may be established.

In the work reported here, the investigations have been followed with these intentions: to investigate the immediate dermal response of a series of pregnant and non-pregnant individuals and to attempt to correlate the clinical findings. The antigen employed was supplied by Gruskin[1] and prepared according to the method described in a recent publication. The series of cases were obtained from the Obstetrical and Gynecological Services of the Long Island College Hospital, and from the private practices of the author and his colleagues. All the cases have been watched carefully and confirmed by subsequent examination.

Technique of Performance. The skin of the inner aspect of the arm is lightly cleansed with alcohol, making sure not to rub the skin to redness, then dried very lightly with sterile gauze. A sterile, absolutely dry, graduated 1 c.c. tuberculin syringe with a dry sterile hypodermic needle of 27 gauge and one-half inch length is employed. After loading the syringe and ejecting all air bubbles, the needle is inserted into the epithelial layer of the skin, so superficially that the aperture of the needle may be visible through the integument, injecting very slowly 0.1 c.c. of the antigen, preventing undue pressure with the plunger so as not to produce false pseudopodia due to tissue injury. The original wheal produced by the injection of the antigen should be perfectly round and have the appearance of "orange peel" or "pig skinning." This appearance of wheal formation assures one that the solution has been injected correctly. In positive cases pseudopodia appear. In negative cases no pseudopodia appear.

Intradermal testing has been replete with discussion as to the degree of reaction, the variation usually being that of personal interpretation rather than alteration of reaction phenomenon. The sine quo non of the Gruskin reaction is the appearance of pseudopodia.

The skin test with the ordinary technique, is, at best, only a relatively crude detector of hypersensitiveness. Attempts to standardize all skin reactions in terms of dimensions of either the wheal or the erythema, or both, should be discouraged. Many normal skins will exhibit erythema with almost any antigen in any type of intradermal testing.

False reactions can be avoided by paying strict attention to controls. The nitrogen content of the Gruskin placental extract is .035 mg. per c.c. with a protein content of .221 mg. per c.c. Every patient tested with the placental extract was also tested with a control solution. A solution of amnion was used as a control and injected intradermally with the same care and technique as the placental antigen. It is a desirable control for it was prepared to contain a like nitrogen and protein content as the placental antigen. It is superior to normal saline solution in that it not only determines those skins which demonstrate dermographia but also those which show a non-specific protein sensitivity. Patients showing a positive control reaction are not suitable for the Gruskin intradermal pregnancy test.

This study embraces a series of 252 cases, many of which presented, at least temporarily, a problem in diagnosis. They were grouped for purposes of analysis and the following results were found:

Total number of cases tested	252
Cases excluded because of positive reactions to control solution	15
Total number of cases employed for summary	237
Total number of pregnancy cases	155
Total number of nonpregnant cases	66
Total number of male patients showing negative reactions to the placental extract	16

ANALYSIS OF CASES BASED ON GRUSKIN INTRADERMAL PREGNANCY TEST

	No. Cases	Per Cent
Analysis of tests in pregnant cases		
Total number of pregnant cases	155	100.00
Correctly positive	149	96.13
Incorrectly negative	6	3.87
Analysis of tests in non-pregnant cases		
Total number of non-pregnant cases	66	100.00
Correctly negative	60	90.90
Incorrectly positive	6	9.10
Analysis of all tests		
Total number of tests	221	100.00
Correct diagnosis	209	94.57
Positives	149	
Negatives	60	
Incorrect diagnosis	12	5.43
Incorrectly negative	6	2.715
Incorrectly positive	6	2.715

PREGNANT GROUP

	Total	Positive	Negative
Women within 1 week of first missed period	5	5	0
Women within 2 weeks of first missed period	9	9	0
Women within 3 weeks of first missed period	9	8	1
Women within 1 to the 2 months after missed period	25	24	1
Women within 2 to the 3 months after missed period	23	23	0
Women within 3 to the 4 months after missed period	29	28	1
Women within 4 to the 5 months after missed period	10	10	0
Women within 5 to the 6 months after missed period	7	7	0
Women within the 6 to the 7 months after missed period	7	7	0
Women within the 7 to the 8 months after missed period	1	1	0
Ectopic Gestation	7	6	1
Abortions			
Threatened abortions	3	3	0
Incomplete spontaneous abortions	14	12	2
Complete spontaneous abortions	4	4	0
Therapeutic abortions	2	2	0

NON-PREGNANT GROUP

	Total	Positive	Negative
Regularly menstruating women	20	0	20
Early menopause	16	0	16
Amenorrhea (endocrine)	5	1	4
Ovarian cysts associated with amenorrhea	7	1	6
Uterine fibroids simulating pregnancy	5	2	3
Chronic pelvic inflammatory disease	8	1	7
Salpingitis with symptoms suggestive of ectopic pregnancy	2	0	2
Lactation amenorrhea	1	0	1
Endometrial hyperplasia	1	0	1
Carcinoma of ovary	1	1	0

SUMMARY AND CONCLUSIONS

1. A review of 252 cases is hereby presented with the findings in respect to the accuracy of the Gruskin intradermal pregnancy test.

2. False reactions are avoidable by attention to details and the routine employment of standardized controls. A group of

individuals with disturbed metabolism, usually of endocrine origin or with skin anomalies are inherently incapable of determinable skin testing. This objection is equally applicable to the Gruskin test as it is to the employment of other non-inflammatory reactions induced by intradermal testing. Disregarding this small group, the test permits of routine application and its validity is asserted by the high percentage of accuracy obtained.

3. Although a discussion of the theory of the Gruskin intradermal pregnancy test should prove fruitful, our chief concern at this time was with its practical application.

4. The simplicity of the test, the rapidity with which diagnosis is made and the high incidence of 94 per cent accuracy are striking. The Gruskin intradermal pregnancy test was correctly positive in 96 per cent, 149 of 155 pregnant women tested in this series; and correct in 90 per cent, 60 of 66 non-pregnant women who yielded a correct negative reaction, also negative in 16 of 16 male controls.

5. I wish to emphasize that while the test is most simple in this performance and reading yet a reasonable conversance should be had in order to permit of ready accurate interpretation. This is stressed with the thought in mind that the utmost care in technique of performing the test should be employed. I would advise anyone who utilizes this test as a diagnostic measure to perform at least 25 tests in order to gain ready conversance with proper technique and reading prior to employing it as a routine diagnostic procedure.

In conclusion I wish to express my sincere thanks to Dr. Alfred C. Beck, Professor and Head of the Department of Obstetrics at the Long Island College Hospital and College of Medicine, and Dr. Alex L. Louria, Clinical Professor of Medicine, Long Island College of Medicine, for their kindly and stimulating interest and for their helpful criticism in the recording of the results.

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MODIFICATION OF BECK'S LOW FLAP CESAREAN SECTION*

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IN HIS "Obstetrical Practice," Beck enumerates six advantages to be gained by the usage of the low flap cesarean section; (1) confining any spill occurring at operation to the lower abdomen militating against generalized infection of the peritoneal cavity; (2) minimizing the danger of peritonitis by completely sealing the uterine wound with a layer of peritoneum; (3) less likelihood of hemorrhage since the placenta is, as a rule, in the fundus; (4) smoother convalescence; (5) the possibility of abdominal adhesions is minimized; and (6) the scar in the uterus is stronger and rupture in subsequent labor rarely occurs. Against these weighty factors but two disadvantages may be cast: (1) the patient must be in labor for several hours in order that a lower segment is developed; and (2) the procedure is technically more difficult than the classical procedure and it requires a longer operating time for completion.

The results of the low flap cesarean section have been observed almost from the date of Beck's original publication. In the fifteen years since that discussion first appeared, opportunity for study of the procedure has been present in over 500 cases. In this experience, of the six advantages stated by Beck, but one, the most important, has stood the test of time, namely, indubitably reducing the incidence of peritonitis. The disadvantageous factors have been unaffected and because of the technical difficulties and greater time consumption for this operation, we have sought to modify Beck's operation so that the disadvantages could be eliminated and yet a means of preventing the occurrence of peritonitis could be retained.

The uterovesical reflection of peritoneum is commonly employed in gynecology. The raw surface of the fundus after the Bell-Beutner operation is peritonealized by mobilizing this reflection and carrying it over the raw area. A similar step is employed by certain operators in correcting retroversion. We have utilized the reflection in peritonealizing the large raw surface remaining after fundectomy. It was this last named procedure which suggested the modification of the low flap section which is presented here.

First operating on the cadaver, we were forced to experiment on the non-pregnant woman, the following fact was observed: if the reflected peritoneum is dissected across the anterior surface of the fundus *at* the white line of firm peritoneal fixation and then separated down to the bladder and the posterior surface of the bladder is mobilized for 2 to 3 cm., the peritoneal flap so prepared will be large enough to completely cover the uterus up to, and on occasion, over the top of the fundus. This state was found in repeated attempts on the cadaver. That such a condition could never occur in the pregnant woman was understood but the enlarging of the uterovesical reflection in pregnancy, the contraction and retraction of the uterine muscle postdelivery and the static character of the peritoneal reflection at the same time, suggested that such a prepared flap might well serve to extraperitonealize the uterine wound. This would preserve the greatest advantage of the Beck procedure. On the cadaver, the preparation of the flap,

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including the mobilization of the bladder required less than one minute and presented no technical difficulty.

The first clinical application of the procedure was made in an elective section in a patient at term and who was not in labor. The flap was prepared by making an opening into the uterovesical fold of the peritoneum at the white line on the fundus. Dissection was carried laterally and then with the finger, the entire reflection was freed and the posterior surface of the bladder mobilized by blunt dissection. The lower uterine segment was not manifest. The uterus was incised for a length of about 10 cm., extending upward from just above the bladder. After the baby, placenta and membranes were delivered, the uterus was closed with interrupted chromic sutures, placed in two layers and the flap then carried over the uterine wound. It was found that it readily extended at least 4 cm. above the superior end of the uterine wound. A running Lembert suture completely extraperitonealized the uterine wound by making the flap fast to the visceral peritoneum of the fundus.

In repeated cases, the time for preparation of the flap at operation has never exceeded two minutes nor has any difficulty been encountered with the peritonealization. In no case has undue tension been placed on the flap in an effort to cover the uterine wound. There has been no difficulty postoperatively and, probably because we have not yet reached 100 cases, we have seen no peritonitis. In the light of previous experience we are forced to this scepticism.

The procedure does live up to what was originally demanded of it; elimination of technical difficulty and excess time consumption and adequate peritonealization of the uterine incision.

Operative Technique. The abdomen is opened by a left paramedian incision, at least 3 to 4 inches in length. An indwelling catheter keeps the bladder out of the field. The lateral blades of a self retaining retractor are inserted and the general peritoneal cavity is walled off by laparotomy pads so that the omentum and the intestines remain invisible throughout the procedure. The patient is now placed in moderate Trendelenberg.

The uterovesical peritoneum is identified and at the extreme upper border, the white line of fixation on the fundus, it is lifted by thumb forceps and nicked with scissors. A blunt instrument or preferably the finger, is inserted into the opening and is worked under the fold, liberating it from the underlying uterus. If this is done by blunt dissection, bleeding of any moment is rarely encountered. When the fold has been freed down to the reflection on the bladder, it is incised laterally along the white line for a distance of 10 cm. *to each side of the midline.* The bladder is then separated from the underlying uterus by the same method, readily finding a distinct line of cleavage. With the flap thus mobilized and prepared, the lower portion of the self retaining retractor is placed under it and held by an assistant.

The uterus is incised in one of three ways; (1) entirely above the white line, (2) entirely below it or (3) partly above and below. Excess spill is prevented by suction and constant sponging. Delivery is effected usually by forceps. While the placenta separates, interrupted sutures are placed in the uterus avoiding the decidua. After delivery of the placenta and membranes, and rarely do we have to perform this manually, the sutures are tied. The wound is closed with two layers of interrupted sutures using No. 2 chromic catgut. The lower retractor is removed and the flap carried over the uterine wound and made fast to the visceral peritoneum of the fundus by a running Lembert stitch. This suture line is started at the center of the flap and run first to the left and then to the right. Thorough peritoneal toilet is performed and the abdomen is closed in layers, usually with three tension sutures and with or without drainage according to the custom of the operator. Because we have found an invariably smoother postoperative course when drainage is used,

we drain all sections. We do not consider that such a procedure will prevent a generalized peritonitis nor do we feel that it will in any way affect any peritoneal infection. In our experience it has rendered the postoperative period more comfortable.

In our hands and in the hands of a few converts, this procedure has been performed as rapidly as the classical section. Over the classical operation it possesses the towering advantage of true extraperitonealization of the uterine wound. It possesses the virtues of Beck's procedure but is utilizable even where no lower segment presents itself and it will save the operator the time he requires for preparation of the flaps according to the usual technique employed.

CONCLUSIONS

1. A modification of the Beck two flap cesarean section is presented with a detailed description of the technique.

2. The procedure offers the advantage of speed of the classical operation in association with the extraperitonealization of Beck.

3. The technical difficulties of the two flap operation are eliminated.

4. The procedure is applicable to any case and is independent of the development of the lower uterine segment.

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AUTOTRANSFUSION

REVIEW OF AMERICAN LITERATURE WITH REPORT OF TWO ADDITIONAL CASES

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BLOOD transfusion has a well established place in modern medicine, and where it is definitely indicated, no substitution therapy has been found to take its place. In most instances the need for blood can be anticipated and ample time is afforded to obtain a suitable donor. It is the patient who is brought into the emergency room in shock with signs and symptoms indicative of a recent severe hemorrhage, or the patient who loses an unforseen amount of blood during an operation, who causes anxiety, for then transfusion is urgent and assumes an importance secondary only to the control of the bleeding. In an occasional case, collection and reinfusion of the patient's own blood is possible, thus eliminating the necessity for waiting until a suitable donor can be found.

Autotransfusion owes its origin to this occasional desperate need for blood and has been used by more than one surgeon who has seen the very blood the patient needed about to be discarded.

William Highmore, writing in 1874, called attention to an overlooked source of blood supply for transfusion in postpartum hemorrhage, remarking that it was not every patient who had a coachman or gardener at her command. Seeing one such patient die for want of blood, it occurred to him that if he had collected the blood, defibrinated and warmed it, and injected it with his Higginson's syringe and transfusion pipe, it would all have been the work of a few minutes, and the only chance of life the poor woman had would have been afforded her. Although he resolved to try autotransfusion on the next case of hemorrhage that occurred in his practice, there is no proof that he ever followed his plan.

On October 21, 1885, John Duncan, Surgeon to the Royal Infirmary in Edinburg, performed the first autotransfusion that is recorded in medical literature. The patient had received a severe crushing injury to the left leg in a railway accident. Amputation was indicated, although Duncan came to the conclusion that it was impossible he should lose his leg and live through the operation. The idea of saving and utilizing the patient's own blood was born of necessity, for he states that

> in a large school like this, there is no difficulty in finding blood-givers during the day, but at night a saline infusion is an imperfect alternative. . . . The patient was anesthetized with chloroform, followed by ether. While I rapidly removed the limb, the blood which fell from it (in all about three ounces) was caught by an assistant in a dish containing a solution of phosphate of soda. After the arteries had been tied, it was difficult for a time to say whether the patient was dead or alive; but I proceeded to inject the blood and phosphate of soda, mingled with distilled water in the last syringeful to increase the quantity. In all, about eight ounces were thrown into the femoral vein on the face of the stump. . . . The pulse had become quite perceptible by the time he had been got into bed; it steadily improved during the night, and the man is now perfectly well. . . . I have now performed it in a sufficient number of cases, one of them an amputation at the hip performed by my colleague, Dr. Miller, to enable me to speak with confidence as to its safety and value.

In Dr. Miller's case, Duncan saved and injected eleven ounces of blood. The reinfusion was followed by a "slight hematuria" which persisted for two days, but there was no marked general reaction, and the patient recovered.

A paper by Thies in 1914, in which he reported 3 cases of ectopic pregnancy benefited by the reinfusion of the blood found in the peritoneal cavity, marks the beginning of the modern era of autotransfusion, there now being an impressive series of cases reported by continental surgeons covering a wide variety of conditions such as ectopic pregnancy, rupture of the spleen and liver, and gunshot wounds of the chest.

In this country, autotransfusion was first performed by Lockwood in 1916. During the course of a splenectomy for Banti's disease, 750 c.c. of blood were recovered from the spleen after removal. At the suggestion of his colleague, Dr. Harlan Shoemaker, this blood was used for transfusion. Six months later he repeated the procedure in a similar case. Because the title of his paper contained no mention of autotransfusion he has not received the credit he merits.

The value of autotransfusion has been impressed upon us by our experience in 2 cases. Both patients entered the hospital in shock, the result of severe hemorrhage, and both probably would have died but for the replacement of some of the blood which we were able to recover for in neither case was a donor available when needed.

CASE REPORTS

Case I. W. W., a colored male, aged thirty years, was admitted to the Passavant Hospital on April 1, 1932, having been shot in the upper left abdomen a few minutes earlier. There was a moderate degree of shock. Examination of the abdomen showed generalized rigidity and a bullet wound in the upper left quadrant. One hour after admission an upper left pararectus incision was made under local anesthesia. On opening the peritoneum the abdomen was found to be filled with blood, 500 c.c. of which were recovered, filtered through several thicknesses of gauze and placed in a flask containing 50 c.c. of a 2 per cent solution of sodium citrate. The abdominal viscera were examined and a tear was found in the upper surface of the left lobe of the liver which was packed with gauze and the incision closed. There was an alarming increase in the degree of shock during the course of the operation. The superficial veins were all collapsed, but a needle was finally inserted into the right external jugular vein and the recovered blood reinfused. The improvement was prompt and the patient left the operating room in fair condition. There was no reaction. His convalescence was entirely uneventful and he was discharged from the hospital on the eighteenth day after admission.

Case II.* C. C., a white male, aged sixteen years, was admitted to the Presbyterian Hospital on November 17, 1934, having been stabbed in the left chest about forty-five minutes previously. He was unconscious, in an extreme state of shock and bleeding profusely from a wound in the third intercostal space about 5 cm. to the left of the midsternal line. Examination of the chest revealed evidence of both fluid and air in the left pleural cavity. The heart sounds were distant and muffled, the rate estimated at between 145 and 150 beats per minute. There was no perceptible radial pulse. The diagnoses were a stab wound of the left side of the chest, probable stab wound of the heart, left hemopneumothorax and shock. The patient was treated for shock, followed shortly by surgical treatment. Under local anesthesia an incision was made along the left margin of the sternum and then extended laterally at its ends between the second and third and the fourth and fifth ribs. The costal cartilages were divided, the parietal pleura incised and the flap retracted laterally. There was so much blood in the pleural cavity that it was impossible to determine the source of the bleeding. With the idea of saving some of the blood for reinfusion, an attempt was made to empty the pleural cavity with a large syringe, but it filled up as rapidly as the blood was removed, so this was abandoned in favor of large dry packs which were plunged into the cavity and were then wrung out into a beaker containing 50 c.c. of a 2 per cent solution of sodium citrate. In this fashion 700 c.c. of blood were recovered. A wound was now apparent which extended through the pericardium and crossed the upper end of the anterior longitudinal sulcus of the heart, having divided the anterior descending branches of the left coronary vessels without entering the ventricle. The heart wound was sutured and the chest wall closed without drainage, a large amount of blood being left in the pleural cavity.

* Note: This case was recently reported in the Journal of the American Medical Association.

While the operation was progressing an intravenous set was assembled and the recovered blood was filtered through several layers of gauze and reinjected into one of the arm veins. The patient had received only 200 c.c. of blood when he began to regain consciousness. A donor was available by the time the operation had been completed, but the patient's condition was considered sufficiently satisfactory not to necessitate the immediate use of any more blood. A Kahn test of the donor's blood was subsequently reported to be positive for syphilis. The patient finally left the hospital eighty-three days after admission, having had a stormy convalescence due to the development of an open pneumothorax and empyema. At no time was there any reaction attributable to the autotransfusion.

Similar reports emphasizing the value of autotransfusion have appeared in American journals with increasing frequency in the last few years, a review of this literature yielding a total of 272 cases in addition to the 2 just reported. There are many more cases which have not been reported, several articles containing casual references to the value of the procedure without including any details of the cases in which it was used. Descriptions of many of the reported cases leave little doubt as to the presence of an acute anemia of an alarming nature or of the urgent demand for transfusion. In the majority of instances in which the amount of blood reinfused was mentioned, 500 c.c. or more were used. Six patients received over 1000 c.c., while one patient received 1600 c.c. It is interesting to note that no deaths were reported from hemorrhage.

Although autotransfusion has found its greatest usefulness in the treatment of ectopic pregnancy, equally gratifying results have been obtained in a wide variety of other conditions. These are tabulated in the table shown in the opposite column.

Non-fatal reactions have been reported in 9 cases, or 3.3 per cent. Five of the reactions were of short duration and were quite similar in nature, consisting of chills, fever and malaise, occurring shortly after the completion of the autotransfusions. In many respects they resembled the reactions occasionally seen following a donor transfusion. Three of these followed the use of citrated blood, although in only one instance was the sodium citrate considered to be the cause. Two reactions reported by Brown and Debenham followed the use of blood obtained from a hemothorax and kept on ice without the addition of sodium citrate for thirty-six and fifty hours respectively before reinfusion. Both reactions were in the same individual, appearing each time after the introduction of 250 c.c. of blood, and were thought to be due to changes taking place in the blood before its use, possibly hemolysis.

Diagnosis	Auto-transfusions
Ectopic pregnancy	211
Intracranial operations	23
Hysterectomy	10
Hemothorax	7
3 gunshot wounds of the chest.	
2 stab wounds of the chest.	
1 stab wound of the heart.	
1 fractured ribs.	
Traumatic injuries to the liver	6
Traumatic injuries to the spleen	5
Splenectomy for Banti's disease	3
Oophorectomy	1
Nephrectomy	1
Secondary intra-abdominal hemorrhage	1
Torsion of pedunculated fibroid with hemorrhage	1
Diagnosis not mentioned	5
	274

The remaining four reactions were more varied. In 2 cases reported by Davis and Cushing there was an alarming fall in blood pressure after only a few cubic centimeters of blood, recovered during the course of intracranial operations, had been reinfused. The reinfusions were stopped and the patients promptly rallied. One case of traumatic rupture of the spleen reported by Coley had no subjective symptoms, but voided a port wine urine the day after the reinfusion of 750 c.c. of blood. The fourth case had considerable vomiting the day following an operation for ectopic pregnancy and reinfusion of 700 c.c. of blood.

Death occurred in 4 cases, or 1.5 per cent. One patient died from bronchopneumonia

nine days after a splenectomy for a gunshot wound of the spleen, having experienced a beneficial effect from the autotransfusion at the time of the operation. The remaining 3 deaths were in cases of ectopic pregnancy, in each instance blood being used which had been present in the peritoneal cavity for over three days. In all 3 of these, death was attributable directly to the autotransfusion, 2 of the patients showing signs of increased shock immediately after the reinfusions, while the third developed a paralytic ileus.

Reactions	Number of Cases
Chills, fever and malaise	5
Fall in blood pressure and shock	4
Hemoglobinuria	1
Paralytic ileus	1
Vomiting	1
Bronchopneumonia	1
	13

Most of the untoward reactions are probably due to the presence of a toxin which appears in the extravasated blood subsequent to the hemorrhage. Experimental evidence would suggest that this toxin is free hemoglobin and that it is present in sufficient amount, after the blood has been in one of the serous cavities for twenty-four hours, to constitute a real danger.

Filatov, working with dogs, found that blood introduced into the pleural or peritoneal cavities underwent a progressive change with a gradual decrease in the erythrocyte count, an increase in the leucocyte count and a change in the clotting elements which prevented coagulation in vitro. Evidence of hemolysis was apparent after sixteen hours and was quite marked at the end of twenty-four hours. Further experiments showed that, while small amounts of hemolyzed blood had no ill effects on animals when introduced intravenously, amounts exceeding 1½ to 2 c.c. per kilogram of body weight produced a condition which he termed "hemolytic shock," consisting of a fall in blood pressure, albuminuria, hemoglobinuria and oliguria. Renal volume studies on denervated kidneys proved the oliguria to be due to spasm of the renal vessels.

Bacterial contamination of the blood is one other possible source of danger in autotransfusion. Although the only criterion of contamination immediately available is the presence of an injury to a hollow intra-abdominal viscus, the danger is apparently remote, there being no such cases reported in this series, and only one case in a far more extensive German literature. This was a case reported by Wolf in which death occurred following the use of blood obtained from the peritoneal cavity of a patient in whom there were injuries to both the liver and the stomach.

Technically, autotransfusion is simple and once the blood has been collected and filtered, its administration is the same as that of any citrate transfusion. Care should be taken in collecting the blood to avoid any unnecessary disintegration of the red blood corpuscles. Although apparently unnecessary, the use of 50 c.c. of a 2 per cent solution of sodium citrate for every 500 c.c. of blood has proved to be the method of choice in most of the cases.

SUMMARY

1. Two cases are reported in which autotransfusion was of marked value.

2. Two hundred and seventy-two additional cases have been collected from the American literature. Non-fatal reactions were reported in 9 cases, or 3.3 per cent. Death occurred in 4 cases, or 1.5 per cent, in 3 of which it was attributable directly to the autotransfusions.

3. Experimental evidence is cited which suggests that most of the unfavorable results are due to the use of hemolyzed blood.

4. Bacterial contamination was the cause of none of the reactions reported in this series. It apparently represents a minimal danger if the source of the bleeding is known and if there are no concomitant injuries to the hollow viscera of the abdomen.

	Author	Auto-transfusion	Diagnosis	Amount of Blood Used	Age of Blood	Treatment of Blood	Reactions	Comment
1	Block, O. E.	1	Traumatic injury to liver	500 c.c.	4 hours	Citrated	None	Life saving
2	Brown, A. L. and Debenham, M. W.	1 2 1	Fractured ribs Stab wound of chest Gunshot wound of chest	360 c.c. 250 c.c. 250 c.c. 1000 c.c.	3 hours 36 hours 50 hours fresh	None	None Chill and malaise Chill and malaise None	Life saving
3	Burch, L. E.	1 2 1	Splenectomy for Banti's disease Ectopic pregnancy Nephrectomy	800 c.c. no mention no mention	fresh no mention fresh	Citrated	None	Pulse barely palpable before reinfusion
4	Coley, B. L.	1	Traumatic injury to spleen	750 c.c.	5 hours	None	Port wine urine for one day	Probably saved life
5	Downing, W. and Larsen, W.	1	Traumatic injury to spleen	1000 c.c.	5 hours	Citrated	None	Recovery
6	Davis, L. E. and Cushing, Harvey	23	Intracranial operations	50 c.c. to 1200 c.c.	5 hours or less	Citrated	Alarming fall in blood pressure in 2 cases	Life saving in 2 cases. Permitted completion of operation in 4
7	Davis, M. B.	1	Gunshot wound of spleen	600 c.c.	3½ hours	Citrated	Died on ninth day, bronchopneumonia	Of immediate value. Pulse barely palpable before reinfusion
8	Farrar, L. K. P.	10 1 1	Hysterectomy Oophorectomy Secondary hemorrhage	15 c.c. to 400 c.c.	fresh	Citrated	Tremor and dusky color in 1 case	Life saving in 1 case. Probably eliminated need for transfusion in 2 cases
9	Kraft, R. W.	1	Traumatic injury to spleen	1600 c.c.	few hours	Citrated	None	Good result
10	Lee, Q. R.	2	Gunshot wound of chest Ectopic pregnancy	1000 c.c. 1500 c.c. 500 c.c.	fresh 6 hours 72 hours	Citrated	None	Striking benefit in all
11	Lockwood, C. D.	2 1	Splenectomy for Banti's disease Ectopic pregnancy	750 c.c. 500 c.c. 500 c.c.	fresh 5 hours	Citrated	None	Striking value. One patient almost exsanguinated
12	MacFee, W. F.	1	Torsion pedunculated fibroid with hemorrhage	500 c.c.	36 hours	None	None	Recovery
13	May, G. E.	2	Ectopic pregnancy	600 c.c. 900 c.c.	2 hours recent	Citrated	None	Recovery
14	Maynard, R. L. and Rees, W. T.	1	Ectopic pregnancy	700 c.c.	48 hours	Citrated	Considerable vomiting	Life saving
15	Rumbaugh, M. C.	1	Ectopic pregnancy	200 c.c.	8 hours	Citrated	None	Saved life. Patient unconscious before reinfusion
16	Ricci, J. V. and DiPalma, S.	11	Ectopic pregnancy	250 c.c. to 700 c.c.	24 hours 7 48 hours 3 72 hours 1	Citrated	None	Life saving. All the patients were in need of blood
17	Robinson, C. M.	3 3	Traumatic injury to liver Ectopic pregnancy	large amount no mention	fresh no mention	Citrated	None	Life saving. All the cases were moribund
18	Seelaus, H. K.	1	Traumatic injury to spleen	800 c c	20½ hours	Citrated	None	Life saving
19	Tiber, L. J.	189	Ectopic pregnancy	no mention	72 hours in 3 fatal cases	Citrated	3 deaths 2 shock 1 ileus	A life saving measure; all 3 deaths followed the use of old blood.
20	Watson, C. M. and Watson, J. R.	1 1	Stab wound of heart Traumatic injury to liver	700 c.c. 500 c.c.	2 hours 2 hours	Citrated	None	Saved life
21	White, C. S.	1 5	Traumatic injury to liver No mention	500 c.c. 500–700 c.c.	30 hours no mention	Citrated	None Chills and fever in 2 cases in latter group	Successful result in all 6 cases

5. In spite of the excellent results obtained in the majority of cases, the occurrence of reactions, some of which may prove fatal, should limit the use of autotransfusion to those cases in which the demand for blood is urgent, and in which there are no contraindications imposed by the age or the source of the blood.

Note

Our attention has been called to an article by Foster and Prey (*Ann. Surg.*, 100: 422–428 (Sept.) 1934), in which 3 cases of traumatic hemothorax treated by autotransfusion were mentioned. There was one immediate, although mild, reaction. A recent communication from the authors listed 2 similar additional cases in which the results were very satisfactory.

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PNEUMOCOCCIC PERITONITIS*

REPORT OF 5 CASES

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PNEUMOCOCCIC peritonitis as an entity is frequently not recognized as the potent factor producing post-operative sequella of some abdominal section, nor as the primary cause in an acute abdominal emergency.

Brechot and Josserand[1] report Bizzalo as the first to describe a case of pneumococcic peritonitis in 1885. The following year Cornil presented a case associated with pericarditis and bilateral pleurisy

The disease is essentially one of childhood, most common under ten years of age. In very young infants and adults the peritonitis is a complication of pneumococcic infection elsewhere, type I usually predominating, while in pneumonia, types 2 and 3 prevails.

Horine[2] attributes 2 per cent of abdominal emergencies in childhood to pneumococcic peritonitis. He reports that 75 per cent of all cases occur in the female under ten years of age and usually are primary, while in boys are secondary in type.

Lyttle,[3] who is interested in the prognosis and treatment of nephrosis in children, indicates that the chances of cure are relatively good but if complicated by pneumococcic peritonitis the mortality will reach 60 per cent owing chiefly to the pneumococcic peritonitis and bacteremia. In Lyttle's analysis of 45 cases of nephrosis in children, death occurred in 51 per cent and recovery in only 24 per cent of the cases in which pneumococcic peritonitis developed.

As the result of early surgical intervention, the initial phases of the peritonitis are now known. Melchior, operating in the twelfth hour, found enlarged mesenteric lymph nodes and a mucin-like exudate, which rapidly became purulent, covering the serous surfaces.

The peritonitis is either localized or diffuse, the localized type occurring twice as frequently. In some cases the lesions in the diffuse type may be insignificant, the patient quickly dying from sepsis while in others, they are characterized by a fibrinous exudate. More commonly, the abdomen contains a large quantity of yellow, grayish-yellow or green pus in which the intestinal loops float without adhesions. Occasionally there are adhesions isolating the exudate in multiple, widespread pockets.

In the typical localized form a collection of pus fills the true pelvis and extends anteriorly in the midline to the level of the umbilicus. Less typical are abscesses in the cul-de-sac of Douglas or the right iliac fossa.

ETIOLOGY

Obadalek,[4] writing on the etiology of pneumococcic peritonitis, proved by rabbit experimentation, inoculating them with small particles of feces, that the infection migrated from the intestinal tract. When operated on early these cases showed the right lower quadrant or ileocecal region to be more acute than elsewhere, by reason of the poor bactericidal power of the lower loops of small intestine and the predisposition to stasis in this area because of Bauhin's valve. He believes the child swallows the pneumococcus and that contrary to the accepted belief of some, the genital tract is not the pathway of entrance, because prior to puberty genital infection seldom ascends. In statistical reports this cannot be taken because of the predominance (75–80 per cent) of females.

* Read before Westmoreland County Medical Society, March 12, 1936.

We can consider Obadalek's opinion in our own cases; in one case no respiratory focus was found, 2 cases had prodromal symptoms of mild respiratory disturbance and 2 cases had definite pneumonias preceding the onset of peritonitis. Transmission through the diaphragm is rare, through the blood stream and lymphatics secondary to a lesion in the respiratory tract is highly important and through the feces and genitalia are both acceptable.

PATHOLOGY

In the first stage of the disease there is no true pus but a thin, serous, turbid, odorless liquid, creamy or grayish-yellow in color, is to be observed in the peritoneal cavity. Diffuse pus is formed in the intermediate stage. The peritoneum feels slippery and slimy, is edematous, but not always reddened markedly. A thick fibrinous exudate with the formation of adhesions and abscesses usually situated in the lower abdomen is encountered in the third stage, usually appearing about the fourth day or thereafter. These abscesses may perforate spontaneously through the umbilicus or into rectum. Coexistent pneumonia, pleurisy or pericarditis are common in cases of general pneumococcus infection.

DIAGNOSIS

It is very difficult to diagnose the disease in the early stages as the onset may simulate any one of the acute abdominal emergencies.

The abruptness of the onset, possibly after prodromal symptoms of respiratory disease or following some vague symptoms referable to the abdominal cavity itself, very often are not considered of any importance when examinating the patient.

Aurousseau[5] states that early diagnosis is only possible in a very few cases unless the respiratory symptoms be such that pneumococcic disease is relatively suggestive. He points out that leucocytosis is more pronounced in pneumococcic peritonitis and the finding of the pneumococcus in the blood is decisive but unfortunately can only rarely be demonstrated.

Wolfsohn,[6] in his last work on pneumococcic peritonitis reports 14 cases, systematically compiles the diagnostic characteristics and emphasizes the fact that with more experience a marked advance in the diagnosis would be recognized. His specific points in diagnosis are a soft, doughy, enlarged abdomen with severe meterorism, diffuse tenderness at various areas and rigid tension.

Huber,[7] writing on the diagnosis of pneumococcic peritonitis in children remarks that,

> At all times, the differentiation from acute appendicitis must be borne in mind, especially because of the operative indication, which is not the same in these two diseases. The most important points are: The distinctly abdominal nature but vagueness of the symptoms; the presence of diarrhea; a frankly general, acute reaction, infectious rather than toxic; the presence of a very significant palpatory sensation of "compactness" instead of a localized contracture; also violent pain in Douglas cul-de-sac upon rectal palpation, not referred to the right side as in appendicitis; vomiting of greenish matter, persisting for a long time without affecting the general condition and without ever becoming fecaloid as in appendicitis; a moderately high temperature contrasting with a very high pulse rate and never showing the initial drop so frequent in other forms of peritonitis.

The symptoms as described by Horine may be violent or fulminating, with hyperpyrexia, cyanosis, rapid pulse and prostration, or the onset may simulate acute appendicitis or intussusception. There may be excessive vomiting during the early acute stage which cannot be confused with the vomiting of obstruction because of its early appearance nor of early appendicitis.

The facies are quite normal in the initial and progressive stage but Hippocratic facies, a frequent sign, may be seen in the third stage. Often there is pain in the left lower quadrant instead of the right lower quadrant and mid-abdomen. Diarrhea occurs in the early stage, especially in the primary infections and only occasionally

in the secondary types but is usually relieved; males are most usually affected. Tenesmus and blood stained mucus sometimes occur. Frequent, painful micturition may be distinctive.

The symptoms as found in our cases were first prodromal of coryza, common cold or pneumonia followed by acute abdominal pain, emesis but not persistently acute, rapid distention of the abdomen, loss of peristalsis and no diarrhea. Our cases suggested either an acute appendicitis or intestinal obstruction of the colon type.

Distinction in the upper abdomen with tenderness and rigidity confined to the lower abdomen is the usual finding upon physical examination. Digital rectal examination should be made, that the presence of any early mass, edema, or bulging in the pelvis may be determined.

Palpation of the abdomen must be done gently and with warm hands, all the while reassuring the patient and distracting his attention. The rectal palpation must never be neglected.

The most constant and distressing symptom we found in our series was the acute meteorism.

The leucocyte count was not always high but a high polynuclear was noted or when a Schilling haemogram was done there was a marked swing to the left.

The pulse rate was invariably out of proportion to the temperature. Evidence of the acuteness of the disease is always out of proportion to other diseases producing abdominal symptoms.

In 2 of the cases, a history of pneumonia preceded; in 2 others prodromes of an upper respiratory disease was not discovered or admitted on examination.

In the other case a definite history of mild influenza preceded the onset of the pneumococcic peritonitis.

TREATMENT

There is no accepted plan for the treatment of pneumococcic peritonitis. If abdominal emergencies can be excluded a medical procedure is advisable in the early stages, with surgery standing by to intervene when localized collections of pus are manifest and the need of drainage imperative.

If obstruction in the intestinal tract "which we feel is not common, in pneumococcic peritonitis because the bowels are not disposed to adhere to each other" develops, it is obvious some form of celiotomy is imperative.

Despite our experience that any form of laparotomy for relief of meteorism in the early stages has been disappointing, I do not feel it should not be considered when the meteorism becomes a mechanical embarrassment to the cardiac and respiratory systems; but, I favor first a test with a spinal anesthetic.

The use of the different serums can be tried and possibly some good derived but they should not be used to the exclusion of other measures. We believe the active use of hot abdominal stupes "regardless of the medicated type" is most important, that fluids by way of veins or rectum should be used judiciously and intelligently, that the patient may secure sufficient support but not become water logged.

We believe duodenal and gastric drainage or lavage imperative. We feel that the use of oxygen is an excellent adjunct in the treatment of peritonitis of any type, that great benefit can be secured by keeping the erythrocytes surcharged and maintaining the CO_2 balance as nearly normal as possible.

The resort to early surgery, except for a definite emergency seems inadvisable, as the mortality when early surgery is done is prohibitive.

The following cases are appended.

CASE REPORTS

Case 1. G. F. aged four years, admitted October 13, 1929 with a history of four weeks illness, starting with vomiting and diarrhea, diagnosed later as pneumonia. This pathologic process apparently subsided when the patient was seized with two convulsions and elevation of temperature. Following this sequence the patient suffered abdominal pain colicky in

type which was never localized. Distention was then noticed to persist regardless of the bowel evacuations, continuously increasing until later fluid was discovered.

November 16, 1929 drainage of the abdominal cavity was done and a large amount of purulent fluid escaped, which was culture, and a drain inserted. It was noted that the bowels were covered by a heavy coating of exudate. The abdominal wall was thick and doughy, forming a dome like wall over the peritoneal cavity. No change in this picture occurred following the drainage.

Cultures reported pneumococci predominating.

Two weeks later an accumulation of fluid necessitated a second drainage. Despite active oral, intravenous and rectal medication the patient succumbed ten days later.

At autopsy the abdominal wall showed infiltration and thickening twice its normal size, acting as a roof over the cavity. The viscera were covered by heavy exudate and numerous pockets of walled in pus.

The lungs showed no areas of induration or thickening. Intrapleurally, in the left diaphragmatic angle was an acute inflammatory area 5–6 cm. in diameter which was considered as a constant focus of infection that continuously fed the peritoneal cavity.

Pertinent facts in the case:

A. Average leucocyte count 12,000 to 14,000.

B. Pneumonia history.

C. Surgery employed late and after definite formation of pus.

D. A persistent focus in left pleural cavity.

Case II. B. L. W. aged ten years was admitted to the hospital February 6, 1933 because of acute pain in her abdomen with active emesis.

The present trouble began one week previously with generalized abdominal pain colicky in character and without change in bowel movements, this continued each day but not sufficiently acute to keep her from school. She attended classes this morning, however, the pain became so severe she returned home and was sent to the hospital by her physician.

Her past medical history was measles, mumps, pertussis and chicken pox. No prodromal symptoms of any respiratory disease could be found antecedent to this illness.

Physical examination shows an acutely ill patient, face flushed and pinched, tongue dry and foul, pulse rapid and weak, temperature 102°. The abdomen is distended, tense but with no irregularities. Percussion shows meteorism and flatness with a doughy or thickened sensation in the abdominal wall. Peristalsis is slow, almost nil. On palpation the greatest area of tenderness is over the appendix.

The nose and throat are clinically negative, no hyperemia seen.

The lungs show no rales either bronchial or vesicular. The genitourinary system is clinically normal.

The laboratory findings showed the urine to contain 3 plus albumin but negative for sugar; and microscopically an occasional hyaline cast and a few heavy granular casts, few pus cells. Blood count showed 4,050,000 red cells, and 6850 white cells; with hemoglobin 70 per cent; polymorphonuclears 90 per cent and small monocytes 10 per cent.

In view of the following history together with the clinical findings, a diagnosis of ruptured appendix was made and an operation was performed.

When the peritoneal cavity was opened purulent fluid escaped. The bowels were inflamed and the omentum was covered by a purulent exudate. This exudate and fluid was more extensive in the right iliac fossa. The appendix did not appear the source of the disease although no other organs showed any focus. The appendix was removed, culture taken, drains inserted and the abdomen closed.

Despite active treatment the patient grew progressively worse and died on the fourth postoperative day.

The culture was reported that stained smears show pneumococcus.

Salient points: A. No previous history of any respiratory disease.

B. Low leucocyte count but high polymorphonuclear cell count.

C. Absence of diarrhea.

Case III. Mrs. H. A., ten days prior to admission to the hospital suffered from prodromes of upper respiratory tract disease. Three days before admission she complained of pain of a low grade type in the lower abdomen but experienced no diarrhea or difficulty with the bowels. The day prior to admission there was annoying fullness and distress in the lower abdomen. The day of admission meteorism became extreme and patient was referred to the hospital because of symptoms of low colonic obstruction.

On admission, at 9 P.M., March 25, 1935, the chief complaint was severe pain in the abdomen with acute distention. Shortly afterward the patient vomited 1000 c.c. of clear fluid and a small amount of flatus was expelled through a rectal tube. Rectal temperature was 98°, pulse 128; blood count (Schilling) showed erythrocytes 4,120,000, hemoglobin 80 per cent; with 9250 leucocytes, juvenile cells 6 per cent, stabs. 71 per cent, segmented 19 per cent and lymphocytes 4 per cent.

On examination at 12:30 A.M. the patient looks acutely ill, the abdomen is distended causing acute embarrassment of respiration, tense and without any irregularities. On percussion, a dull tympanitic note is found with extreme tenderness in lower half, more dullness is noted in lower half than in epigastric region. On auscultation some peristalsis is found of the spasmodic type. A slight hyperemia is noted in the nose and posterior throat. There is no clinical evidence of any pathology in the lungs. The genitourinary system is clinically negative.

Urinalysis revealed 1 plus albumin and microscopically a few red blood cells, occasional coarse granular casts and a few epithelial cells.

The tentative diagnosis is intestinal obstruction, as the history of respiratory and pelvic prodromes were not available or discovered at this time. It seemed imperative that some operative proceedure must be done to relieve the abdominal distention which was producing an intolerable distress and marked dyspnoea.

The abdomen was quickly prepared, the patient sent to operating room where under a local infiltration anesthesia with novocaine one-half per cent, a two inch incision was made in the midleft quadrant. When the peritoneum was opened a turbid fluid gushed forth, the amount we were unable to estimate. The coils of intestine were inflamed, but not to the same degree as the parietal peritoneum which was acutely inflamed, infiltrated and edematous. An ileostomy tube was introduced and several cigaret drains inserted in the peritoneal cavity.

The presenting picture of the abdominal cavity was diagnosed as pneumococcic peritonitis which was confirmed the following morning by the laboratory as pneumococcus type II, as were cultures from the upper respiratory tract.

On returning the patient to bed a duodenal tube was introduced and suction started. Large doses of antipneumococcic serum were used together with blood transfusions, venoclyses of 10 per cent glucose in NaCl, 200 c.c. per hour, and oxygen was given continuously. Despite this active treatment the patient succumbed twenty-four hours later.

Salient points: 1. The prodromes of respiratory disease.

2. The low grade uncomfortable pelvic distress, not incapacitating patient.

3. The clinical symptoms of colonic obstruction.

Case IV. Mrs. B., aged thirty-three years, was referred to the hospital at 8 P.M., May 21, 1935, because of acute pain in her abdomen of three days duration. For several days prior to this attack the patient had not felt well which she attributed to a mild cold, not of sufficient severity to seek medical aid. The abdominal pain only became acute the preceding day. Her past medical history was irrelevant.

On physical examination the patient looks sick, temperature 101°, pulse 130, respiration 22.

Blood count revealed red cells 4,420,000, hemoglobin 85 per cent, white cells 30,050 with polymorphonuclears 92 per cent, small monocytes 6 per cent and large monocytes 2 per cent.

Abdominal inspection showed marked meteorism and rigidity. Palpation gave a doughy feel, superficial tenderness, marked in lower half, but did not reveal any tumors or irregularities. Percussion showed a dull tympanic note and caused exquisite pain. Rectal examination was negative except for tenderness found in right cul-de-sac. Again surveying the abdomen it was believed we probably had a pneumococcic peritonitis and drainage should be established. Accordingly the patient received intravenous fluid of 10 per cent glucose in NaCl during the night. This case at no time had any diarrhea.

At operation, on incising the peritoneum a large quantity of semipurulent fluid escaped. The parietal peritoneum was acutely inflammed and edematous, the bowels appeared less acutely inflammed and the abdominal cavity contained little exudate. The appendix was mobilized and inspected, showing an equal amount of inflammation of the bowel. We mobilized the ileum for 30 cm. and discovered a diverticulum 6 cm. in length that had an appearance similar to the parietal peritoneum. A culture was taken, several drains inserted and the abdomen closed.

The patient received antipneumococcic serum, blood transfusions and glucose and saline intravenously.

The culture was reported as pneumococcus, type I.

She died one week later.

Salient points:

1. Type I pneumococcus obtained from peritoneal cavity.
2. The high leucocyte count.
3. The absence of diarrhea.
4. The history of influenzal symptoms prior to onset of peritonitis.
5. The relatively typical abdomen.

Case V. T. C., fifty-three years old, was referred because of hematuria. His past history was irrelevant excepting for vesical distress for which he had been treated for many years. After a careful survey was made a large vesical calculus, 3 × 2.5 × 1 cm. was located in his bladder and retrieved by suprapubic cystotomy under spinal anesthesia.

On the third postoperative day evidence of pneumonia became present which developed into a frank pneumonia of the lower left lobe. At the onset of this complication a subtotal anuria developed for thirty-six hours.

The pneumonia reached a crisis on the sixth day, recovery progressed nicely until the evening of his twelfth day when he complained of slight pain in lower abdomen, that was not definitely determined.

His night was undisturbed. At 7 A.M. the following day emesis occurred. At my visit about 10 A.M. nothing was present to account for this; the temperature, pulse respirations were normal, and no lung, intestinal or urinary symptoms were present. The suprapubic dressings were urine soaked and changed.

On his thirteenth postoperative day he had vomited several times within an hour and about 3 P.M. his condition had become critical.

On visiting him he was found in state of collapse, cold, clammy skin, covered with perspiration, weak thready pulse and incoherent. The other most alarming symptom was anuria, no urine being passed since a change of dressings in the morning. Stimulation and venoclyses of 10 per cent glucose in NaCl were instituted, plus heat to the extremities and renal region. Oxygen was given continously by intranasal tubes. He later reacted from the collapse, became warm with rapid pulse and during the night the temperature reached 106°. Slight meteorism was noted in the abdomen; however, the bowels had moved twice during night.

About 8 A.M. the following day the dressings were noted to be moist with urine and during the day so copious was the urinary output that he could not be kept dry.

His temperature dropped to 102.6° rectally and pulse to 120.

Examination showed no respiratory complications or other evidence of new pathology but increasing meteorism with low peristalsis was observed. Three different enemas were given without effect during the day. On examination at 8 P.M. meteorism was distressing, producing increased dyspnoea.

Evidence of acute peritonitis and a dull tympanic percussion were noted with cardiac and respiratory rhythms found in the lower left quadrant. Rectal examination showed a mass in sacral cavity, most marked on the right.

It was imperative to obtain some relief from the distention in order to alleviate the embarrassed respiration.

A spinal anesthesia gave no result after a fifteen minute period. The peritoneal cavity was opened, a large amount of serous amber fluid escaping. The intestines and parietal peritoneum were acutely inflamed, and of the edematous type. An ileostomy was done releasing a large quantity of intestinal contents. Cigaret drains were introduced and the small incision closed. A blood transfusion was given and the patient returned to bed.

The following day the condition continued critical, the toxemia being acute. The abdomen was silent but still distended. The cultures showed pneumococcus. The patient succumbed suddenly at 8 P.M.

Salient points:

1. Uncomplicated operation for vesical calculus.
2. A frank pneumonia in lower left lobe of five days duration with complete resolution.
3. A total anuria of twenty-four hours on the twelfth postoperative day.
4. Pelvic distress twelve hours before onset of anuria.
5. Malignant meteorism of the ileus producing impending death by mechanical asphyxia.
6. Causative factors producing anuria.

CONCLUSIONS

We have reviewed the history of 5 cases of pneumococcic peritonitis and the

literature pertaining thereto and the following deductions appear adequate to set forth:

1. That the pathways of migrations are:
   - A. Blood stream.
   - B. Gastrointestinal tract.
   - C. Genitourinary system.
2. The diagnosis is most difficult, and in many cases a differential diagnosis cannot be made prior to celiotomy.
3. That no constant chain of symptoms can be considered in the diagnosis.
4. That a preceeding history of prodromes of upper respiratory tract infections is an excellent lead in diagnosis of obscure acute abdominal lesions.
5. That the most harrassing element in treating pneumococcic peritonitis is meteorism or paralytic ileus.
6. That early surgery is contra-indicated unless for relief of meteorism and late surgery to drain accumulated purulent exudate.
7. That neither medicine nor surgery has reduced the mortality below 80 per cent.
8. That the present methods of diagnosis and treatment are wholly inadequate to combat this virulent disease.

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SPINAL ANESTHESIA

PROCAIN CONCENTRATION CHANGES AT SITE OF INJECTION IN SUBARACHNOID ANESTHESIA*

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IN the hundreds of publications on spinal anesthesia during the past seven years, the fundamental problem of what happens to the procain injected in the subarachnoid space has hardly been touched. The total data consists of a few scattered analyses under widely varied conditions and by analytical methods of doubtful validity which in many cases are not even specified. Clinical evidence on this point is difficult to interpret. In our clinic, careful observations on approximately 11,000 anesthesias have proved that more analytical data under carefully controlled conditions is needed.

A brief micro-method for the quantitative determination of procain in cerebrospinal fluid has been reported,[1] consisting of the precipitation of procain by vanillin and potassium mercuric iodide in dilute acid and the photometric estimation of the precipitate redissolved in tribasic sodium phosphate. Thereby it is possible to determine with fair precision, amounts of procain from 0.2 mgm. to 1.5 mgm. in a volume up to 4 c.c. Qualitatively, however, the reaction gives a definite precipitate with less than 0.04 mgm. As a first step, this method has been applied to study the concentration of procain in the cerebrospinal fluid of humans at the site of injection at various time intervals after its introduction.

Fifty-six patients who were operated on under spinal anesthesia were studied. Each received an injection of 150 mgm. of procain[1] dissolved in 3.5 c.c. of cerebrospinal fluid at the interspace between the second and the third lumbar vertebras. The patients were then placed in 5° to 8° Trendelenburg position.

Samples of about 1 c.c. of cerebrospinal fluid were withdrawn from the injection site of various patients at different times, some before and some after operation. They were analyzed for procain content in duplicate or triplicate and from these analyses a composite curve was plotted (Fig. 1).

The striking thing about this curve is the extremely rapid fall in the first five minutes and the very slow tapering off during the rest of the duration of anesthesia. Since the 3.5 c.c. of injected spinal fluid contains 150 mgm. of procain, the concentration at the instant of injection is 43 mgm. per c.c. By the end of five minutes this has already fallen to 2.9 mgm. per c.c. From here on, the fall in concentration is very much slower. At ten minutes it is 2.0 mgm. per c.c. and at sixty minutes 0.5 mgm. per c.c.

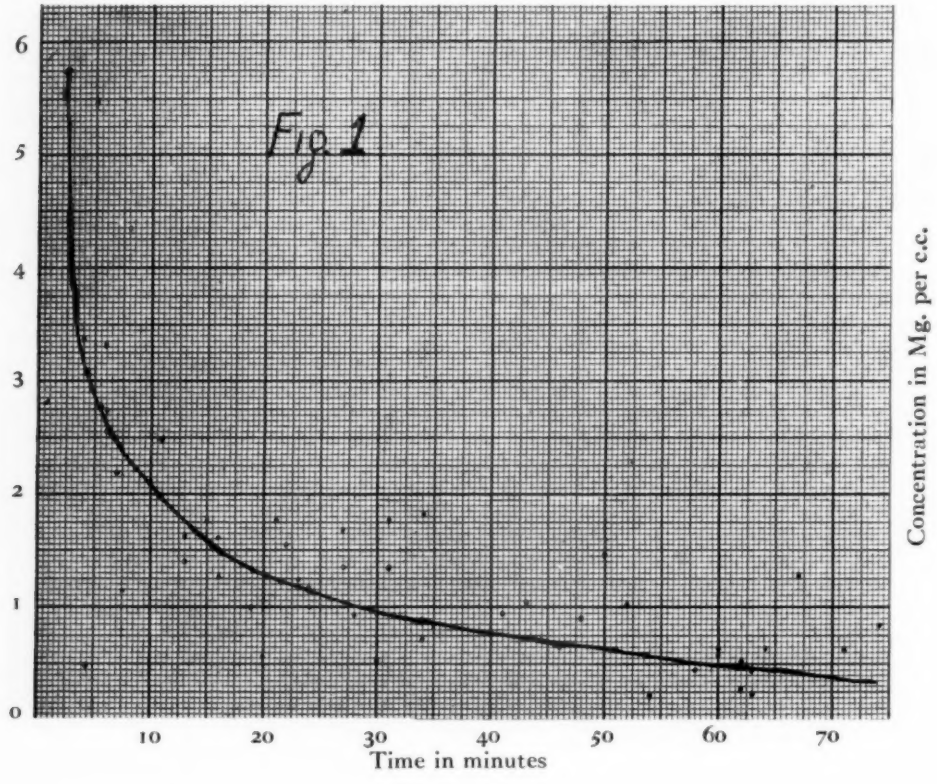
A priori, at least two factors determine the change in concentration at the site of injection. One of these is the rate at which the injected anesthetic spreads away and the other is the rate at which it is destroyed or used up locally. Since it is usually during the first five minutes that the anesthesia reaches its full extent, it is likely that the initial rapid fall in concentration at the site of injection is due to the spread of the anesthetic. This is so rapid that very little of it can be accounted for by simple diffusion, a process which would take days to bring about so large a change in concentration.

On the other hand, since little further change in the extent of anesthesia occurs after the first five minutes, the slow disap-

[1] The commercial preparation used in these experiments was neocaine.

* From the Surgical Service and the Richard Morton Koster Research Laboratory of the Crown Heights Hospital. Aided by a grant from the Anglo-French Drug Co.

pearance of the anesthetic during the rest of the anesthesia is probably due to local utilization or destruction. Anesthesia remove their legs. The results of analyses on 12 such patients shown in Table I are remarkably similar to the minimum con-



mains clinically unchanged until about sixty minutes after its beginning when the concentration of procain is about 0.5 mgm. This value was determined by analyzing samples of spinal fluid taken from patients at the time when they were first able to

Table I

No. of Observations	Time in Minutes	Mgm. Procain per c.c.
7	53.5	0.15
46	58.0	0.44
47	60.0	0.65
48	60.0	0.59
49	62.0	0.54
50	62.0	0.29
51	63.0	0.46
52	63.0	0.23
1	63.5	0.26
53	64.0	0.65
54	67.0	1.27
55	71.0	0.62
Average..	62.0	0.51

centrations necessary for intracutaneous anesthesia as compiled by Hirschfelder and Bieter[2] from the reports of many observers.

In 3 cases in which the anesthetic, 150 mgm. procain, was apparently successfully injected into the subarachnoid space, no surgical anesthesia developed and it was necessary to repeat the injection to obtain anesthesia. Before repeating the injection samples of cerebrospinal fluid were withdrawn for analysis. The analyses of the 3 samples withdrawn are listed in Table II.

Table II

Concentration of anesthetic in cases which failed to develop surgical anesthesia after apparent successful injection of anesthetic in the subarachnoid space

No. Observations	Time in Minutes	Mgm. per c.c.
64	5.0	0.31
27	6.0	0.00
28	7.0	0.00

Since it has been shown that successful anesthesia wears off after the concentration at the site of injection has fallen to about 0.5 mgm. per c.c., it is fair to assume that anesthesia was not developed in these cases because no procain or an insufficient amount was injected into the subarachnoid space. How this might occur has been discussed.[3] It is quite probable that this explanation holds good for all other cases in which, after apparent injection of an anesthetic, anesthesia fails to develop.

Many investigators,[4–7] having observed phenomena obtained by injecting colored fluids in artificial cerebrospinal systems made of glass tubes have drawn conclusions by analogy regarding the behavior of anesthetics in cerebrospinal fluid. In order to check the validity of such analogy we repeated procain concentration experiments on a glass tube bent to conform to the contour of the average spinal canal.

The artificial spinal fluid used was prepared according to the description of normal spinal fluid given by Greenfield and Carmichael with a pH of 7.6 and a specific gravity of 1.006.

The injections of 150 mgm. of procain dissolved in 3.5 c.c. of artificial cerebrospinal fluid were made through a rubber joint at a point corresponding to the junction of the 2nd and 3rd lumbar vertebras and the entire column tilted into 5° to 8° Trendelenburg. Samples were taken at the injection site at intervals of five, ten, twenty, forty and sixty minutes after the injection and analyzed for procain content. After each sample was taken the tube was washed, refilled with artificial cerebrospinal fluid and new procain injected. All these samples contained less than 0.01 mgm. procain per c.c., although the total fluid volume of 130 c.c. contained approximately 1.2 mgm. per c.c., i.e., no procain was destroyed. The procain was seen falling toward the cephalad portion of the model after injection and much of it was recovered from what corresponds to the cisterna.

Table III

PROCAIN IN GLASS MODEL (WITH STIRRING)

Time in Minutes (after Injection)	Concentration at Site of Injection in Mgm. per c.c.
5	2.78
10	1.87
15	2.23
20	1.86
40	1.86

These findings are so different from what occurs in humans that the phenomena must be of an entirely different nature.

In the attempt to further approximate conditions in the human, the glass tube experiments were repeated with the addition of stirring, to simulate the pulsating action of cerebrospinal vessels, by means of a wire spiral running through the entire length of the tube. The spiral wire was drawn back and forth about one-half inch at the rate of 72 movements per minute. Samples were withdrawn five, ten, fifteen, twenty and forty minutes after injection, a new set-up being used for each sample. The results of the analyses of the samples given in Table III are much closer to the findings in human beings, but still quite different. One apparent reason for the difference is that in the glass tube the procain is not used up as it is in the human, but it is probable that the type of curve of concentration obtained in humans is due in part at least to the stirring effect of vascular pulsations.

Table IV

SPINOCAIN IN GLASS MODEL

Time after Injection in Minutes	Concentration of Procain at Site of Injection in Mgm. per c.c.
(WITHOUT STIRRING)	
10	19.40
20	12.40
60	13.30
(WITH STIRRING)	
10	2.48
40	2.17

The behavior of spinocain,[6] an anesthetic solution of less specific gravity, was also investigated. The results with and without stirring are seen in Table IV. The differences between the behavior of procain and spinocain in the unstirred artificial system are apparently due to the specific gravities of the injected solutions. If permitted, the heavy one sinks from the site of injection

and the light one remains, since the site of injection is at a high level. However, when the fluid is agitated the phenomena related to specific gravity are prevented from developing in their simple form. The parallelism between the concentration of the light spinocain and the heavier procain in the agitated system at the site of injection is particularly interesting.

Since the slight change made in our glass model by introducing the factor of stirring gave such profound differences in concentration of injected anesthetics, it should be apparent that in no glass model or cadaver can the conditions existing in the living be so closely approximated as to justify conclusions by analogy. What is needed is more data on humans.

SUMMARY AND CONCLUSIONS

In 56 patients anesthetized by injecting 150 mgm. of procain into the subarachnoid space, the concentration of anesthetic at the site of injection was determined at various intervals after the injection.

The concentration was found to fall rapidly during the first ten minutes and very gradually for the remainder of the duration of the anesthesia.

The average concentration at the point of injection, at the time when anesthesia wears off was found to be 0.5 mgm. per c.c.

Data are given suggesting an explanation for the occasional failure of anesthesia to develop after the apparent introduction of the anesthetic agent in the subarachnoid space.

It is indicated that information derived from the behavior of anesthetics or colored liquids in artificial models or cadavers cannot be used to interpret the phenomena of spinal anesthesia in human patients.

Of the four possible factors, (1) diffusion, (2) gravity, (3) mechanical distribution and (4) local utilization or destruction, probably only the last two play any significant role in the change of concentration at the injection site.

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INTRAVENOUS IODIN IN PREOPERATIVE TREATMENT OF HYPERTHYROIDISM*

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FOR the past few years we have been interested in observing the effect of intravenous administration of comparatively large amounts of iodin in patients with hyperthyroidism. This form of therapy was not adopted as a routine but was used only occasionally in the beginning of the study, but recently, we have been using it more frequently. Observations have been made in about 50 cases so that at the present time we are prepared to record some definite clinical impressions. Due to numerous difficulties and misunderstandings regarding the timing of iodin administration and basal metabolic determinations, statistical and laboratory data to confirm the clinical impressions are not available in all of these cases. In making this report, 20 cases were selected indiscriminately except for the requirement that they be complete as to all pertinent data and diversified so as to represent a cross section of the type of cases treated.

That our position relative to thyroid disease may be understood, it should be mentioned that this clinic is located on the edge of the Great Lakes goiter belt. The majority of goiters that we see are the nodular or adenomatous type, either toxic or non-toxic. Toxic diffuse goiters, or exophthalmic type, however, are encountered not infrequently. We are in agreement with those[1,2] who maintain that the hyperthyroidism of toxic nodular goiter, or toxic adenoma, and that of toxic diffuse, or exophthalmic, goiter are one and the same disease, and any difference in the clinical manifestations of the disease in the two groups of cases is attributable largely to the degree and rapidity of intoxication and to differences in the age at which the toxicity develops. One might say that toxic diffuse goiter is an acute rapidly fulminating intoxication most frequently affecting youths and young adults, while toxic nodular goiter is an acute or subacute exacerbation of a chronically recurring intoxication occurring oftener in older individuals.

In making this study satisfactory checks of basal metabolic determinations at two to five day intervals were obtained first in all patients. On the day of the last metabolic determination iodin administration was started, 1.0 gm. of sodium iodide or 10 c.c. of a 10 per cent solution, was given intravenously and twice this amount the following day. On the third day after the first injection of sodium iodide the basal metabolism was determined. The trail and error method of some of our earlier observations supplied the indication for the proper timing of the post-iodin basal metabolism. There were slight variations in this routine in some cases. Sodium iodide was used as being less depressing than the potassium salt. During this three day period the patients were closely observed clinically. To my knowledge no disagreeable symptoms of iodism resulted from the administration of this amount of iodin except in 2 or 3 patients all of whom had previously received iodin orally.

In evaluating the results of these experiments we have considered definite clinical improvement, both objective and subjective, associated with a decrease in metabolic rate as indicative of an iodin response. I personally followed most of these patients clinically but, to avoid any possible prejudice, they were also observed by others not directly interested in this study. The results may be briefly summarized as

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follows. The majority of patients showed rapid clinical improvement associated with a decrease in basal metabolic rate within the three day period. The remainder showed little or no appreciable change in either regard. At present no explanation of this failure to respond is apparent. The improvement was similar in character to that noted when iodine is administered orally over a longer period, but being much more rapid and abrupt, it was often startling. Patients in whom nervous symptoms predominated seemed to show most marked clinical improvement, objectively and subjectively. In some instances there were indisputable physical changes in the thyroid gland, such as hardening of the gland, diminution or disappearance of thrills and bruits. And wherever there was a diminution in the clinical manifestations of the disease there was a commensurate drop in the metabolic rate in the same time period of three days. For the 20 cases appearing in Chart 1, this decrease averaged 54.5 per cent, varying from 35 per cent (Case 24181) to 79 per cent (Cases 57007 and 73820).

CHART I

THE FIRST FIVE CASES ARE OF THE DIFFUSE TYPE OF GOITER. THE REMAINDER ARE CASES OF NODULAR GOITER. THERE IS NO ESSENTIAL DIFFERENCE IN THE REACTION TO IODIN IN THE TWO GROUPS OF CASES

Case Number	Age	Sex	Pre-iodin		Amount Iodine Intravenous		Post-iodin		Per Cent Decrease, B.M.R.	Time, Days
			B.M.R.	Pulse	Doses	Total, Gms.	B.M.R.	Pulse		
77004	47	F	39	120	3	4	10	106	74	3
88909	52	F	48	90	3	2.5	22	78	54	4
78789	24	F	21	90	2	3	6	70	71	3
83957	34	F	60	118	2	3	34	118	43	2
83957 (2nd adm.)	34	F	32	120	2	3	14	115	56	5
72529	49	F	39	90	3	4	17	90	56	4
24181	27	F	45	96	2	2.6	29	80	35	3
59980	38	F	27	105	2	3	11	94	60	3
95219	42	F	34	90	2	4	17	80	50	4
73820	14	F	44	100	2	2	10	100	79	3
92699	50	F	56	110	2	3	30	95	46	3
85699	53	F	66	106	2	3	38	100	42	3
60863	27	F	43	100	1	2.5	13	90	70	3
57007	31	F	43	100	2	3	9	80	79	6
94236	42	F	52	100	2	3	24	100	54	4
84738	44	F	49	116	2	3	26	100	47	2
89592	46	E	83	110	2	3	44	80	46	2
67904	56	M	25	100	2	2	8	90	68	3
65078	25	F	50	100	2	3	21	84	58	4
76455	70	M	72	100	2	3	39	100	46	3
Average.....	40	..	46.4	...	2.1	2.98	21.1	...	54.5	3.3

The 20 cases included in this report include 5 instances of toxic diffuse goiter and 15 of toxic nodular goiter. There were 2 males and 18 females with ages varying from fourteen to seventy years. Chart 1 presents the pertinent data in these cases. As can be seen at a glance there was no essential difference in the behavior of the two types of cases as treated, so they may be considered together. The highest pre-iodin basal metabolic rate recorded was 83 per cent above normal (Case 89592).

The lowest was 21 per cent above normal (Case 78789), the average being 46.4 per cent; hence these are representative cases both as to type and severity of toxicity. In 17 cases the amount of sodium iodin administered intravenously over a period of two days was 3 gms. or under, while in 3 cases 4 gms. were given with an average of 2.98 gms. The greatest decrease in metabolic rate amounted to 79 per cent of the pre-iodin level in Cases 57007 and 73820 and the smallest was 35 per cent in Case 24181. The average post-iodin metabolic rate was plus 21 per cent, a decrease of 54.5 per cent from the pre-iodin average. In 13 this drop occurred in three days or less from the time the iodin was first given and in the remaining 7 cases the time varied from four to six days. In the majority of these cases this increase in time is only apparent and is misleading. Most of them showed clinical improvement within the usual time period but metabolic determinations properly timed to demonstrate the minimum interval were not obtained. However, the average time required to secure the reduction in metabolic rate for the entire group was 3.3 days from the time iodin was first injected.

It can be readily seen that by the intravenous administration of iodin as given in these cases an entirely satisfactory iodin remission was secured in a comparatively short time as far as basal metabolic rate is concerned. The average decrease, of 54.5 per cent closely approximates that seen in our cases in which Lugol's Solution was given orally. The average decrease in the latter cases was 44 per cent in a period of ten days. These figures correspond in general with those reported by others.* Thus Starr[3] reported a reduction in basal metabolic rate of 50 per cent in all goiters in fifteen days following administration of 15 to 45 m. of Lugol's per day; Rienhoff and Thomas[4] observed a 36.8 per cent drop in an average of 11.8 days using varying amounts of Lugol's; Clute and Mason[5] observed a maximum effect in eight to twelve days; Cutler and Zollinger[2] recorded a 30 per cent reduction in metabolic rate in eleven days in cases of toxic nodular goiter and 67.7 per cent in 15.6 days in cases of exophthalmic goiter. In our cases in which large amounts of sodium iodide were given intravenously comparable reductions in metabolic rate were obtained in the unusually short time of 3.3 days. In other words, by administering iodin intravenously in amounts averaging 2.98 gms. an iodin remission can be secured in one-third to one-fourth the time required when iodin is given orally in the customary amounts. Aside from the practical time saving considerations, this rapidity of response raises interesting questions which will be discussed later.

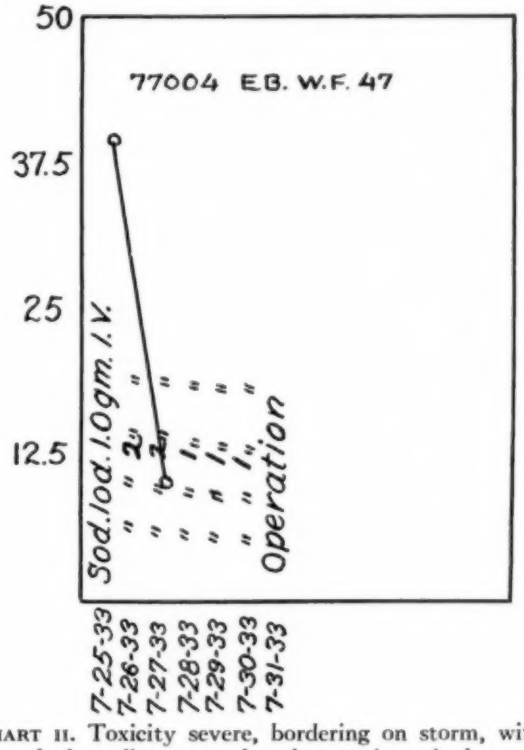

Chart II. Toxicity severe, bordering on storm, with marked cardiac, mental and gastrointestinal symptoms making metabolism tests impossible. Twenty-four hours after 1.0 gm. NaI intravenously condition had improved sufficiently to secure satisfactory test of plus 39 per cent.

As stated above our general impression is that these patients showed clinical

* Winkerwerder and McEachern report an average decrease of 50 per cent in metabolic rate in an average of 13.5 days in a group of 144 patients treated at the Johns Hopkins Hospital. *Johns Hopkins Hosp. Bull.*, 51: 263 (Nov.) 1932.

improvement consistent with the decrease in metabolic rate. This improvement was manifested by less restlessness and nervousness as observed by staff members and nurses. Whenever such objective improvement was noted the patient invariably volunteered that, subjectively, there was also much improvement, less palpitation, less nervousness. Systematic observations of the pulse rate other than the routine by the nurses were not made, but my impression is that in general any slowing of the pulse seemed to lag behind other signs of remission. The following case illustrates the rapid clinical improvement often noted, particularly as regards gastrointestinal symptoms.

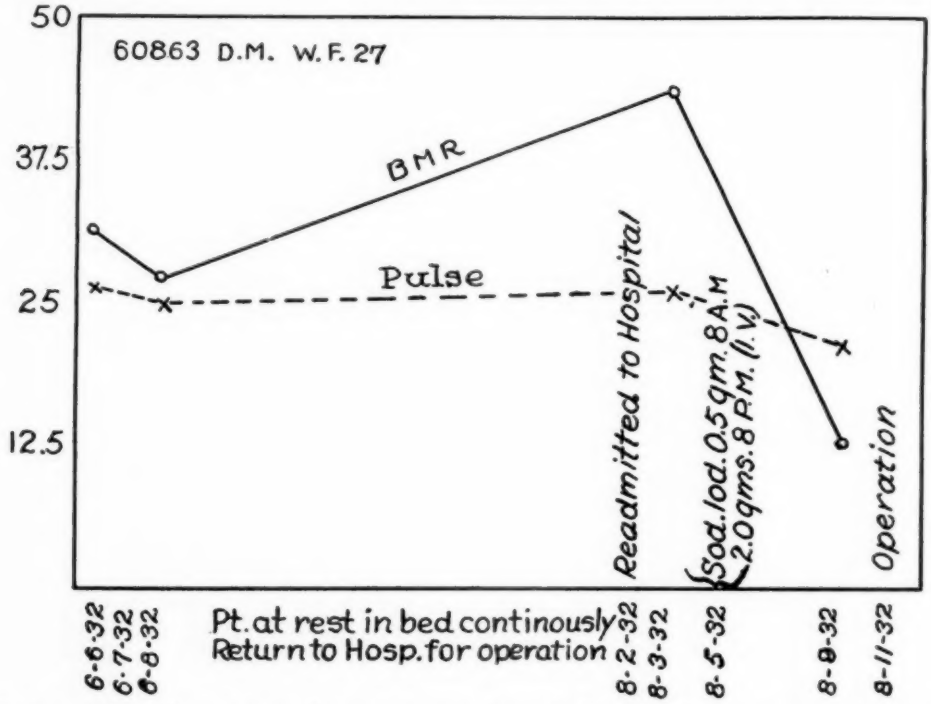

Chart III. Toxic nodular goiter. B.M.R. plus 43 per cent. A total of 2.5 gm. NaI intravenously in twelve hours. Operation six days later without further iodin administration.

Case E. B. (77004). The patient a white female, married, aged forty-seven years, was first admitted to the hospital June 29, 1933 complaining of abdominal pain, nausea and vomiting. She had had an appendectomy fifteen years before admission, bilateral breast resections for adenomata three years later, a bilateral salpingo-oophorectomy and myomectomy five years before admission. Questioning revealed that she had had a "nervous breakdown" sometime during the past "several years." The present illness started three weeks before admission with an "infected throat" and soreness in various muscles and joints, malaise and anorexia. Beginning two days before admission she began to have generalized abdominal pain with nausea and vomiting which was constant. In addition she had been running a daily elevation in temperature to 100°F. Questioning revealed increasing nervousness and fatiguability, increasing prominence of the eyes, and a weight loss of 15 to 20 lbs. during the previous four to five months.

Physical examination showed the temperature to be 37.8°C. with a pulse rate of 140. The patient appeared extremely nervous and overactive. There was evident considerable loss of weight, and the skin, which was warm and moist, showed atrophy of the subcutaneous tissue. There was slight but definite exophthalmos without any other thyroid eye signs. Pulsation of the vessels of the neck was very marked. The thyroid was moderately enlarged, smooth and soft without any thrills or bruits over the superior poles. The tonsils were enlarged but there was no evidence of acute infection in the nose and throat. The lungs were

clear on percussion and auscultation. The heart was slightly enlarged to percussion and on auscultation a soft systolic murmur was audible over the whole precordium; the rhythm was regular. The pulse was of the water hammer type with a rate of 140 and a pressure of 140 systolic and 60 diastolic. Abdominal examination was essentially negative except for the lower midline scar around which there was slight tenderness without any spasm, rigidity, or masses.

Laboratory examination showed a leucocytosis of 16,400 and the urine to be negative except for numerous pus cells.

By the morning of June 30 the patient had been seen by four members of the house staff and one senior staff member all of whom agreed that the patient had hyperthyroidism but that it did not explain the entire picture. Intestinal obstruction, rheumatic fever and pyelitis were additional diagnoses considered. However, the hyperthyroid symptoms seemed to be increasing and on "general principles" the patient was given 1.0 gm. of sodium iodide intravenously because it was felt that a "storm" was imminent. Within twenty-four hours after the iodin administration, all nausea, vomiting and abdominal pain had subsided, the patient was quieter, less restless and her general condition appeared improved. The pulse rate was 110 as compared to 120 to 140 previously. So marked was the improvement that members of the senior staff who subsequently saw the patient doubted the existence of any hyperthyroidism. Small amounts of Lugol's had been started by mouth the day following the intravenous iodin. The metabolic rate on July 3, three days after intravenous iodin was only 10 per cent above normal. By July 8 the patient was afebrile, calm and quiet, continued free from gastrointestinal symptoms and had a pulse rate of 80. Lugol's had been continued daily. The difference of opinion regarding diagnosis still existed, many doubting more and more the diagnosis of hyperthyroidism made on admission. To settle the question all iodin was discontinued and she was discharged from the hospital with instructions to return immediately should any of her symptoms return.

Sixteen days after discharge she was readmitted with the same symptoms as she had had on her first admission. At home she had remained in bed because of increasing weakness, nervousness and rapid heart. Five days before admission she suddenly began to have persistent nausea and vomiting which was present on admission.

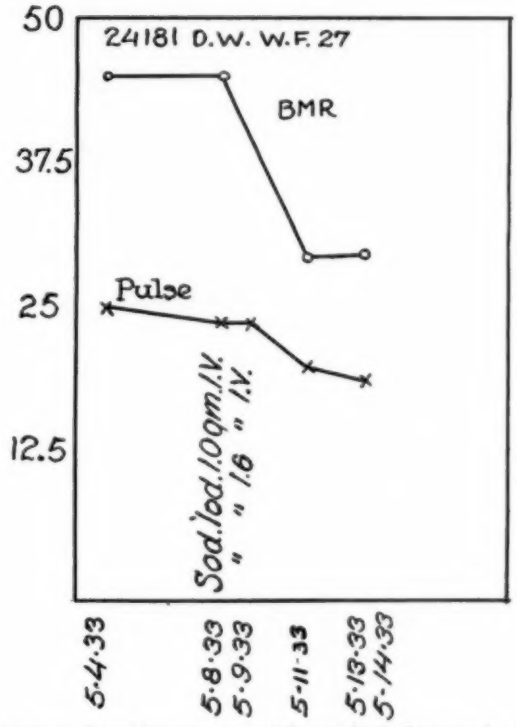

Chart iv. Rapid response with marked changes in the thyroid gland, diminution of thrills and bruits, coincident with drop in metabolism.

Physical examination was essentially the same as on the first admission except that all the manifestations of hyperthyroidism were more marked. The temperature was 37.4°C., the pulse 120 to 130, and the blood pressure 160/0. She was extremely talkative, restless and nervous and her whole appearance gave the impression that she was bordering on delirium. There was still some question as to the coexistence of a partial intestinal obstruction.

She was immediately given 1.0 gm. of sodium iodide intravenously and as on the first admission, there was, as expressed by the interne's note, "an almost immediate response." All nausea and vomiting stopped. The patient became and remained much quieter, in fact quite calm. Twenty-four hours after the iodin her condition was such that a perfectly satisfactory metabolic determination was done, a procedure which was impossible at the time of admission. The rate was plus 39 per cent. I believe this is considerably below what it would have been at the time of admission had a determination then been possible. Intravenous

sodium iodide in amounts of 1.0 and 2.0 gms. per day was continued (Chart II). On July 27, three days after admission the metabolic rate was plus 10 per cent. The pulse varied from 100 to 110.

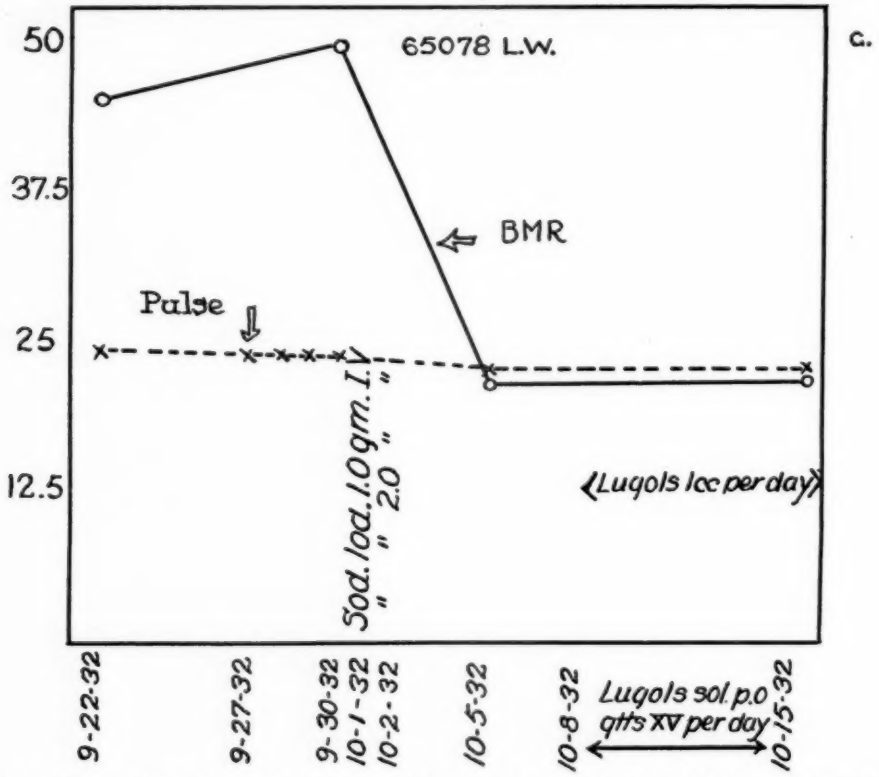

CHART V. A toxic nodular goiter showing a 58 per cent decrease in metabolism within four days following 3.0 gm. NaI intravenously. Iodin orally for eight days failed to lower B.M.R. any further, showing completeness of iodin remission.

Subtotal thyroidectomy was successfully performed one week after admission and the patient had an entirely satisfactory recovery. The pathological report showed this to be a diffuse type of toxic goiter with marked hyperplasia and lymphocytic infiltration.

Her subsequent course has been uneventful.

This case is an excellent example of the extremely rapid, even dramatic response which is occasionally seen following large amounts of sodium iodide given intravenously. It is unfortunate that it was impossible to secure a metabolic determination before iodin administration on either admission, but in each instance the extremely poor condition of the patient, the hyperactivity and the vomiting made it impossible. The rate of plus 39 per cent on July 25 was obtained 24 hours after 1.0 gm. of sodium iodide was administered. Two days later after an additional 2 gms. the rate was plus 10 per cent. One might question these determinations if it were not for concurrent startling clinical improvement. On the second admission the patient's mental condition was so confused that the history could be elicited only from relatives. Within twenty-four hours she was perfectly oriented and coherent. Furthermore it seems reasonable to assume that the cessation of the nausea and vomiting following iodin administration was not a coincidence but was directly attributable to the iodin in as much as it occurred twice, each time within twenty-four hours. Goetsch[6] comments on the particular efficacy of intravenous iodin in cases with gastrointestinal symptoms. Considering the fact that all those signs and symptoms of hyperthyroidism which improve under prolonged administration of iodin by mouth, showed the same improvement in this case within twenty-four hours after intravenous

iodin, we feel that there is a significant cause and effect relationship. Of course such cases as this are not frequently encountered but we have observed others which are almost as dramatic.

Changes in the physical characteristics of the thyroid gland associated with clinical improvement of the patient are exemplified by the following cases.

Case D. M. (60863). The patient, a white female, married, aged twenty-seven years was first admitted to the hospital on May 17, 1932, complaining of swelling of the neck, which had first appeared following an abscess of the right cheek four weeks before admission. A short time before the development of the abscess she had noticed some thyroid enlargement. A history of nervousness and irritability associated with slight loss of weight in spite of an increase in appetite over a period of 1 to 2 years was elicited on questioning.

Physical examination showed a well developed, well nourished young woman in considerable discomfort. The temperature was elevated to 37.5°C. and the pulse rate was 120. The eyes, ears, nose and throat were essentially negative. There was a healing abscess on the right cheek. The teeth were in extremely poor condition. Below the right mandible there was a large mass of acutely inflamed, indurated, firm, tender glands which showed no evidence of fluctuation. The thyroid was visibly enlarged and on palpation was found to be nodular and moderately firm. The left lobe was the size of a moderate sized orange, the right lobe being only slightly smaller. There were no thrills or bruits heard over the gland. The lungs were clear throughout but the heart, while not enlarged and regular in rhythm, showed a soft systolic murmur at the apex which was not transmitted. The pulse was regular but rapid, rate 120. The blood pressure was 134 systolic with a diastolic of 68. Abdominal, pelvic and rectal examinations revealed no abnormalities. The extremities were negative and the reflexes were normal.

Laboratory examinations of the blood, urine, and stools revealed no abnormalities.

The involved lymph glands gradually softened and were incised twelve days after admission. Following this the patient's temperature which had been elevated previously, became normal, but the pulse rate remained high varying between 90 to 100. In addition, there was a gradual but progressive loss of weight despite an excellent appetite and adequate food

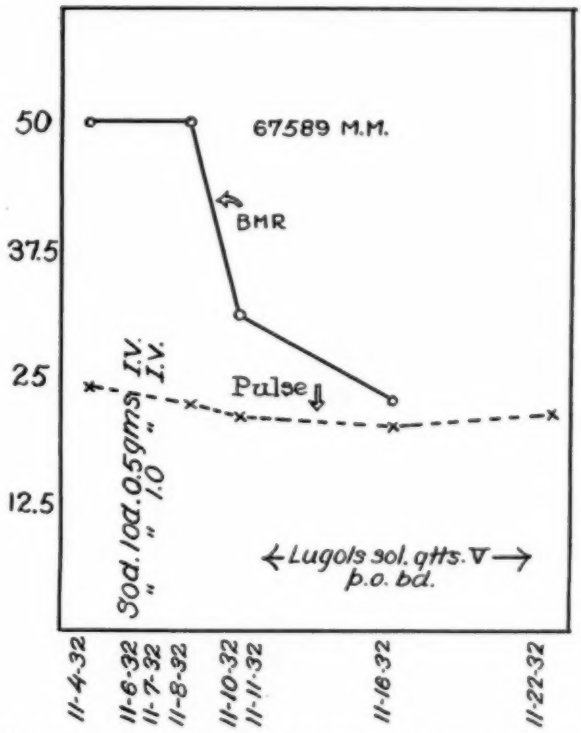

Chart VI. A satisfactory, but not maximum remission following 1.5 gm. NaI intravenously, with further drop in B.M.R. with Lugol's solution orally.

intake. On June 6, three weeks after admission, the patient's metabolic rate was plus 31 per cent and on June 8 plus 27 per cent. She was placed on a high caloric diet, (3500–4000 calories; weight 56 Kgms.) and during the next two weeks gained 2.6 Kgms. It was felt that the increased thyroid activity might well be due to a thyroiditis, secondary to chronic and acute infections and that conservative treatment consisting of prolonged rest in bed, sedatives and continued high caloric diet should be tried. She was sent home on this regime on June 24.

The patient was readmitted to the hospital on August 2, approximately six weeks after discharge. While at home she had remained constantly in bed. Nervousness had increased and dyspnea, palpitation and excessive perspiration had become prominent symptoms. She had lost 2 Kgms. in weight.

Physical examination showed essentially the same findings as on the previous admission. The pulse rate was 104 and blood pressure 140/80. In addition there were loud bruits over

both superior poles of the thyroid gland which had not been present during the previous admission. The basal metabolic rate the day after admission was plus 43 per cent.

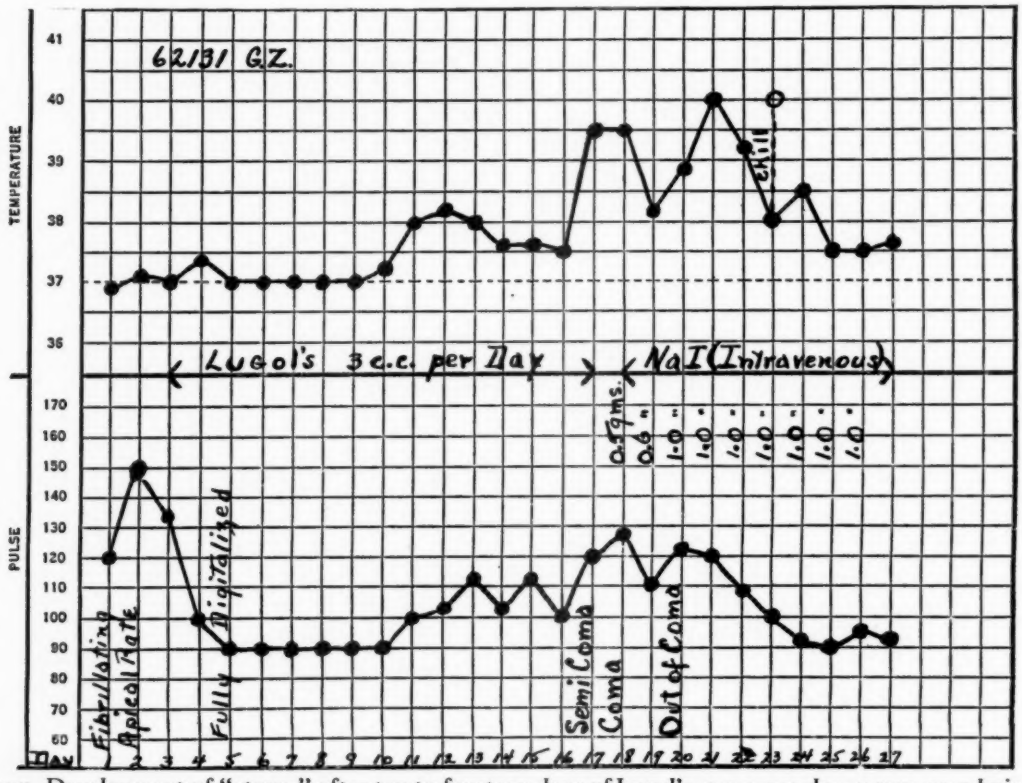

CHART VII. Development of "storm" after ten to fourteen days of Lugol's, 3 c.c. per day. B.M.R. on admission plus 59 per cent; on sixteenth day, plus 51 per cent. Patient recovered from "storm" after receiving 3 gm. NaI intravenously.

On August 5 the patient was given 0.5 gms. of sodium iodide at 8 A.M. and 2.0 gms. at 8 P.M. (Chart III). No further iodin was given. There was marked clinical improvement in forty-eight hours. On August 8 a note appears "The patient appears much calmer, pulse somewhat slower (80–90). The thyroid seems smaller, the bruit much softer and less extensive." On the same day the metabolic rate was plus 13 per cent.

On August 11, six days after admission, without any further iodin other than the 2.5 gms. on August 5, a subtotal thyroidectomy was performed successfully. The patient had an uneventful recovery and was discharged from the hospital August 22. The pathological report showed this to be a nodular type of toxic goiter.

CASE D. W. (24181). The patient a white single female aged twenty-seven years, was admitted to the hospital May 2, 1933, complaining of nervousness. The present illness started four to five years before admission with increasing nervousness, prominence of the eyes for 1 to 2 years, and marked increase in appetite for six months. In addition she complained of some palpitation, tremor of the hands, intolerance to heat, but very little weight loss. Her past history was essentially negative.

Examination disclosed a fairly well nourished young woman who was extremely nervous and restless and continually moving about the bed. There were typical lesions of psoriasis over the arms, legs, and trunk. The eyes showed a marked exophthalmos and lid lag. The ears, nose and throat were essentially negative. The enlargement of the thyroid involved both lobes and the isthmus. The gland was firm and somewhat nodular, with an easily palpable thrill and a very loud bruit over both superior poles. The lungs were clear on percussion and auscultation. The heart was slightly enlarged with a moderately loud systolic murmur which was transmitted to the axilla and was audible over the whole precordium. The pulse was regular in force and rhythm with a rate of 100

and a pressure of 130 systolic and 45 diastolic. Abdominal, pelvic and rectal examinations were negative.

Laboratory examination showed the blood, urine and stool to be negative. An *x*-ray of the chest was negative except for confirmatory evidence of cardiac enlargement. On May 8 the basal metabolic rate was plus 45 per cent.

On the same day as the metabolic determination the patient was given 1.0 gm. of sodium iodide intravenously and 1.6 gms. the following day. Two days after beginning iodin a note by a senior member of the medical staff reads "The intensity of the bruit over the thyroid has diminished markedly in comparison with what it was before getting iodin." On May 11, the metabolic rate was plus 29 per cent (Chart IV). On May 12 the patient was much quieter and less nervous. The thrill and bruit were almost absent and the pulse rate varied between 80 and 90.

A subtotal thyroidectomy was performed on May 15 and the patient was discharged from the hospital on May 25 after an uneventful recovery. The pathologic report showed this to be a nodular type of toxic goiter.

Both these cases while not so dramatic as the first case, again demonstrate the rapidity with which clinical improvement often occurs. In addition they emphasize the point noted that there is often an equally striking and rapid change in the physical characteristics of the thyroid gland itself. The indisputable diminution in the intensity of the thrills and bruits, confirmed by several observers, occurred in 48–72 hours. And as has been noted previously, an accompanying drop in metabolic rate serves as corroboration of the clinical observations.

The question naturally arises as to the completeness of the iodin remission in these cases. As is true with the oral administration, the degree of improvement and the time required for the same varies. In some cases the response is more gradual and a metabolic determination at the end of forty-eight to seventy-two hours will not represent the lowest level to which it will go. However, in many cases the remission is complete in this length of time using 3.0 gms. of sodium iodide, and further oral administration of Lugol's results in no additional improvement. In Case 65078 shown in Chart V, Lugol's solution over a period of one week produced no further lowering of the metabolic rate. On the other hand, Case 67589 (Chart VI) did show a further decrease upon subsequent oral administration of iodine. It should be noted, however, that in this case only 1.5 gms. of sodium iodin was given intravenously, which is one-half the usual dose, and we have noted rarely a complete response with this amount of iodin. In some cases it appeared that, after obtaining a satisfactory remission by the intravenous administration, subsequent oral administration failed to maintain the improvement and there was a return of symptoms and elevation of the metabolic rate. We were unwilling to jeopardize the patient in such instances and usually operated as soon as it appeared, as if an escape from the iodin effect was imminent, so we cannot say that the symptoms would continue to increase in severity. A possible explanation is that a certain amount of iodin is necessary in each case for what might be termed "iodin saturation." When such an amount has been absorbed or assimilated by the thyroid the response is complete and if operation is not performed an escape from the iodin effect ensues. In the case of the intravenous administration all this may occur within a few days.

The efficiency of the protective mechanism of the iodin as given in the short space of a few days is indicated by a few cases which were operated within a few days after iodin was given, as in Case 60863 (Chart III) and Case 85699. The latter was operated six days after beginning iodin and, as can be seen from Chart I, the hyperthyroidism in this case was rather severe. Both of these cases had no more postoperative reaction than is seen after the prolonged oral administration of iodin. We have similarly treated other cases with satisfactory results, but do not make it a regular practice.

We wish to emphasize the value of the intravenous administration of large amounts of sodium iodide in cases of thyroid crises. We have encountered a number of cases in which a crisis appeared imminent. In such cases large amounts of iodin have been given immediately and in most instances within twelve to twenty-four hours symptoms have subsided to a point where a diagnosis of "storm" seemed absurd to those seeing the patient for the first time. Cases of fully developed "storm" in which the diagnosis was unquestionable have been very successfully treated in this manner. In our earlier cases we questioned the value of this treatment, but have come to feel that our failure in an occasional earlier case was due to insufficient amounts of iodin. Enough cases of both these types have now been observed to convince us that the rapid and dramatic response is more than a coincidence. The following cases will serve as examples.

Case G. Z. (62131). The patient, a white married female, aged forty-six years, was admitted to the hospital June 20, 1932 complaining of a swelling of the neck. Her thyroid had first shown enlargement during childhood and had continued to gradually enlarge over a period of years. She dated her present illness three weeks before admission when during the course of her housework she "suddenly felt very weak and toppled over." There had been noted increasing nervousness, profuse perspiration, edema of the ankles and increasing fatigue. She admitted losing 15 pounds in weight in three weeks in spite of an increased appetite. Palpitation and dyspnea were denied.

The patient was a very much undernourished and extremely nervous white woman of forty-six years who appeared to be more nearly sixty-six years. The temperature was 37.5°C., the pulse rate 120. There was marked atrophy of the subcutaneous tissue, the patient obviously having lost considerable weight. There was no exophthalmos but there was a very definite lid lag and the pupillary reactions were normal. The ears, nose and throat were essentially negative. The thyroid was tremendously enlarged, soft and nodular. The right lobe was the size of a small grapefruit, the left lobe being only slightly smaller. The isthmus was also much enlarged. Loud bruits were audible over both superior poles. The lungs were clear to percussion and auscultation. Cardiac dulness extended 10.5 cms. to the left in the fifth interspace, and there was a soft systolic murmur audible over the entire precordium. The pulse was regular in force and rhythm with a rate of 120 and a pressure of 170 systolic and 70 diastolic. Abdominal, pelvic and rectal examinations were essentially negative. There was a fine tremor of the extended fingers. There was slight edema of the ankles. Reflexes were normal.

Laboratory examinations showed the blood count and urine to be negative. The Wassermann was 4 plus. An electrocardiogram the day after admission showed evidence of a damaged myocardium and auricular fibrillation. The latter developed during the evening of the day of admission.

The day following admission the patient was much more restless and nervous. She was also quite dyspneic and was found to be fibrillating. She was quickly digitalized and soon returned to a normal rhythm. Lugol's solution, 1 c.c. three times per day, was started immediately on admission. A high coloric diet and large amounts of fluids were well taken. During the first sixteen days the patient was in the hospital, her condition remained essentially unchanged. Her metabolism on July 6 was plus 51 per cent compared to 59 per cent on admission. Her condition subsequently became worse. The pulse became more rapid and the temperature rose daily to 38°C. She became mentally confused and at times failed to recognize her surroundings. Beginning July 6 it became necessary to administer fluids subcutaneously and intravenously, 2000 to 3000 c.c. normal saline and 10 per cent glucose being given each day. She still took food and some fluid by mouth and continued taking Lugol's. There were no gastrointestinal disturbances. On July 8 the patient was semicomatose, her condition having become suddenly and rapidly worse during the night. A note on that day by a member of the senior staff reads, "It is evident that she will not stand any type of operative procedure at present. She has not responded at all to iodin administration and in spite of energetic treatment, she has failed to respond." The temperature rose sharply to 39.5°C. per rectum and the pulse to 120 after being digitalized. The same treatment consisting of Lugol's by mouth, large amounts of fluids intravenously and subcutaneously was continued but in addition sodium iodide was

given intravenously, beginning with 0.5 gms. on July 8, 0.6 gms. on July 9 and thereafter 1.0 gm. daily (Chart VII). It should be noted that the first two doses were comparatively small and it was not until July 11, the fourth day of intravenous therapy that the patient had received a total of 3.0 gms., the amount usually given in 48 hours. On July 10 two days after beginning intravenous therapy the patient seemed slightly improved and more rational. On July 11, clinically she appeared much improved but her temperature rose sharply to 40°C. and the pulse to 120. On this day she received her fourth intravenous injection of sodium iodide, making a total of 3.1 gms. On the following day the temperature and pulse began to drop. All observers noted much improvement and the patient was more lucid. From this time on improvement continued, and except for an elevation of temperature to 40°C. on July 13, the trend of the temperature curve continued downward to reach normal on July 15. During this period of intravenous iodin administration it was noted that the thyroid became harder and smaller.

The patient was operated July 19 because it appeared that she had shown maximum improvement and there was some evidence that she was beginning to escape from the iodin effect. A subtotal thyroidectomy was done. The patient expired within twenty-four hours. Whether or not the operation might have been successfully performed by the "stage" method is conjectural.

The diagnosis of thyroid storm is undoubted in this case. It is interesting to note that it developed during the period of iodinization in a patient who had never before received iodin, and in spite of the most careful treatment. It is also quite evident to those who watched the progress of this case that the intravenous iodin was responsible for the rapid improvement noted.

This case also exemplifies an occasional observation which we have made that in some cases an iodin response will be obtained following intravenous administration when a rather prolonged course of Lugol's by mouth has failed to produce a satisfactory remission. In this instance 3 c.c. of Lugol's per day over a period of seventeen days failed to give any improvement, in fact, on the seventeenth day the patient presented the typical picture of "storm." However, forty-eight hours after a total of 3.1 gms. of sodium iodide had been given intravenously the patient's condition showed marked improvement, she was no longer comatose and her temperature had dropped from 40°C. to normal. The point naturally arises as to whether or not in giving Lugol's there is adequate absorption from the gastrointestinal tract in all cases. In the case just quoted there were no gastrointestinal disturbances to explain poor absorption and, in the light of experience and the work of Thompson and his co-workers,[7] 1 c.c. of Lugol's three times a day would seem to be more than sufficient iodin to produce a remission.

Case S. P. (108673). The patient, a white married female fifty-one years of age entered the hospital November 4, 1935 complaining of weakness and vomiting of three weeks duration. Her present illness began approximately six months before admission with loss of weight despite an increase in appetite, increasing nervousness and fatigue. She also noticed some palpitation and shortness of breath on exertion. Heat intolerance had also been an increasingly annoying symptom. Three weeks before admission the patient began to vomit and this continued to the time of admission. She had retained practically no food and only small amounts of liquids. Two weeks before admission she developed a "sore throat" with hoarseness, so that she was able to speak only in a whisper. In the three weeks prior to admission the patient became extremely weak and suffered from dyspnea and orthopnea. The past history was essentially negative except for the fact that she had had a small goiter of many years duration and since childhood had supposedly had a "leaky heart," said to have been made worse by scarlet fever nine years before admission.

Physical examination showed an emaciated, acutely ill patient who seemed to be wavering between hyperexcitability and coma, "one moment twisting excitedly and the next lying quiet as if moribund." The skin of the face and neck was flushed and moist although the mucous membranes of the mouth were dry and acetone odor to the breath. Vomiting was

frequent. There was moderate cyanosis of the lips and nail beds. The patient could speak only in a whisper and with considerable effort. There was a suggestive lid lag. The nose and throat was negative. There was a moderately large soft nodular goiter with thrills and bruits over both superior poles. The lungs were clear. The heart was somewhat enlarged, regular except for frequent extrasystoles, with a systolic murmur audible over the whole precordium. The apical rate was 150. The radial pulse rate was 130 with a pressure of 130 systolic and 68 diastolic. Examination of the abdomen, pelvis and rectum was negative. There was a rather course tremor of the fingers and the reflexes were normal.

Examination of the blood showed a red cell count of 5,210,000 with 14.3 gms. of hemoglobin. The white cells numbered 18,450 with a normal differential. Chemical analysis of the blood showed a CO_2 combining power of 27 vol. per cent, chlorides 630 mgms. non-protein nitrogen 56 mgms. The urine was clear yellow, acid, with a specific gravity of 1.015, albumin 1 plus, sugar negative, acetone and diacetic each 4 plus; microscopic examination showed numerous granular casts and 5–6 pus cells per high power field.

A diagnosis of toxic nodular goiter with early storm was made and treatment started immediately, the patient receiving 500 c.c. of 10 per cent glucose and 2 gms. of sodium iodide intravenously, followed by 2000 c.c. of 5 per cent glucose subcutaneously. Nine hours after admission her condition appeared worse. She became stuporous and semicomatose. At this time she was given 1 gm. of sodium iodide intravenously and was placed in an oxygen tent. The blood pressure had dropped to 120/60. On the morning after admission she appeared much improved although she was still somewhat drowsy. Vomiting had stopped and she was taking some fluids by mouth. She was given 1000 c.c. of 10 per cent glucose and 1.0 gm. of sodium iodide intravenously in the morning and in the evening. On the following morning, forty-eight hours after admission, she was much improved and was removed from the oxygen tent. The heart murmur was heard only faintly, and the extrasystoles had disappeared. She was given the same amount of glucose and sodium iodide as on the previous day. On November 7, three days after admission a note in the history states that the bruits over the superior poles were no longer heard, while on November 8, it is noted that "the state of storm has subsided, and the thyroid is smaller and firmer." The pulse rate had dropped to 100 and thereafter remained in the neighborhood of 90. The last intravenous iodin was given on November 7 when 1.0 gm. was given, making a total of 8 gms. in four days. On November 11, seven days after admission the first metabolic determination possible was done. It was plus 13.5 per cent above normal, and the pulse rate varied from 78 to 88. On November 20, nine days later, during which time she received 30 ℳ of Lugol's per day, a partial thyroidectomy was performed. On November 26 the remainder of the thyroid was removed. The patient had an entirely satisfactory recovery.

All observers agreed that this patient was in "storm." The amount of intravenous sodium iodide given in this case was the largest we have ever given, a total of 8 gms. in four days. Within the first twelve hours after admission to the hospital she had received 3 gms. Improvement was noted twelve hours later. As in Case 77004 the nausea and vomiting responded promptly. By the third day, after 5 gms. of iodin, the bruits over the gland had disappeared and on the fourth day she was out of the "storm." Seven days after being admitted her basal metabolic rate was 13.5 per cent above normal. For a case of thyroid "storm" to recover so completely in a period of seven days and show at the end of this time an elevation of metabolism of only 13.5 per cent is unusual. We feel that the result is at least in part attributable to the almost heroic administration of iodin intravenously. We have treated other cases of "storm" just as vigorously except that iodin has been administered orally and have never seen any such rapid response, in fact in some of these cases we have not been able to combat the crisis successfully.

This case also shows what large amounts of iodin can be given intravenously without the patient experiencing any unpleasant symptoms.

COMMENT

Undoubtedly the intravenous administration of iodin in hyperthyroidism has been

used extensively by many and of course we claim no priority. At the time we began our observations we were unfamiliar with any literature on the subject and consequently approached the problem without any preconceived ideas as to what the results might be. The work was well under way and we had noted the general trend of the results before encountering the observations of Goetsch.[6] In a general discussion of the problems of hyperthyroidism he devotes one paragraph to a brief account of his personal experiences with intravenous iodin. No data are quoted but his experiences and impressions coincide with ours. He states that he has noted a rapid effect, efficacy in crises, an added response over and above the drop from oral iodin in overiodinized patients, and a further more complete response in patients in whom oral administration is only partially effective. He also noted it to be especially effective in patients with gastrointestinal symptoms. Frick,[14] in 1926, in the course of a discussion of iodin therapy in general briefly refers to the efficacy of iodin intravenously in hyperthyroidism. He states that 1.0 gm. of sodium iodide in 10 c.c. of water for each 45.3 kilograms of body weight resulted in a 40 to 50 per cent drop in the metabolic rate. This observation was made on 2 cases only. Graham[8] in 1927 stated: "I have gained the distinct impression that the greatest advantage occurs when the hypertrophic and hyperplastic thyroid is involuted to the colloid state by comparatively large doses of iodin in a comparatively short period of time."

In reviewing the literature on the relation between iodin and the thyroid gland, it is apparent that the results noted might have been anticipated on the basis of experimental work. In 1915 and 1916 Marine and his associates[9,10] showed by experiments in vitro and in vivo that the absorption of potassium iodide by the hyperplastic thyroid gland is almost instantaneous. In perfusion experiments averaging one hour in duration, the perfused thyroid regularly showed a marked increase in iodin content, the increase often amounting to several hundred per cent. The same results were obtained when potassium iodide was injected intravenously in dogs. Within five minutes after the intravenous injection of 50 mgms. of potassium iodide in the anesthetized dog a large increase in the amount of iodin per gram of thyroid could be detected in biopsy specimens. The striking feature of these latter experiments was that the major part of the iodin increase occurred within the first few minutes after the injection. Any increase in iodin content in later specimens (1 to 30 hours) was almost negligible. In some of the experiments in which the possibility of loss through the kidneys was eliminated, it was demonstrated that the thyroid has a selective affinity for potassium iodide so injected, since careful analyses of the liver, spleen, thymus, and kidneys failed to show any detectable iodin. It was also noted that definite histologic changes, which are always involutionary, were apparent in twenty hours after injection although they were more marked in thirty-six to forty-eight hours, and that the more marked the hyperplasia, the greater was the ability of the thyroid to absorb iodin.

Marine and Rogoff[11] also showed that there was a definite difference in the pharmacologic action of controls and iodinized glands in relationship to their effect on tadpole metamorphasis. The altered effect in the case of the iodinized gland manifested itself as early as eight hours after the intravenous injection of the solution, but was more marked after twenty hours. "This seems to indicate that the morphologic changes are closely related, in time, to and dependent upon the elaboration of the iodin containing hormone, and that the generally held view that involutionary changes in the gland are the result of a decrease in function of the thyroid cells and a storage and increase of the pharmacologically active principle—the iodin containing hormone—in the gland is essentially correct." In other words the absorption of iodin by the thyroid gland is almost instantaneous, but assimi-

lation of absorbed iodin and elaboration of the hormone is relatively slow. Even so this occurs in the course of a few hours.

VanDyke has shown experimentally the selective action of the hyperplastic thyroid of the dog in relation to the absorption of various iodin compounds.[12] Of several iodin compounds injected intravenously he found that iodin in the form of inorganic iodide was most readily and completely absorbed by the gland. We have therefore been giving our patients the most usable form of iodin as far as absorption by the gland is concerned.

We have not as yet any observations on this form of treatment using smaller amounts of iodin. The amount of sodium iodide which we gave our patients was selected rather arbitrarily but with full realization that it was far in excess of the accepted requirements of the thyroid gland. The amounts used are excessive when one considers the observations of Thompson and his coworkers[7] who found that 1 ♏ daily of compound solution of iodin orally was sufficient to produce a remission. The fact that by far the larger portion of the iodin in 30 minims of Lugol's administered daily is excreted in the urine in cases of exophthalmic goitre[13] indicates that such an amount is in excess of that which is absorbed and assimilated by the hyperplastic thyroid and therefore in excess of the amount necessary to control toxicity. Whether or not iodin other than that bound by the thyroid gland exerts any influence on excessive metabolism is not as yet known. It is barely possible as suggested by Cattell[13] that with larger doses "more iodin may be taken in the gland temporarily with some benefit." An occasional observation in which smaller amounts of sodium iodide were injected without the satisfactory results noted, suggests that there is some value in the larger doses. Further work using smaller amounts of iodin is being undertaken to clarify this point.

One point should be emphasized, namely that we are not advocating the intravenous administration of iodin to be followed immediately by operation as a routine procedure. While in many cases it is possible by this treatment to secure a complete remission within three days and operate immediately with complete safety, such a procedure should be limited to cases of low toxicity of short duration, and to those without coexisting cardiac disease. Practically all of our cases have received iodin orally over varying periods of time following the intravenous injections.

SUMMARY

Observations on the effect of the intravenous administration of large amounts of sodium iodide in cases of hyperthyroidism are recorded. In a group of 20 cases reported in detail an average of 2.98 gms. of sodium iodide was given in forty-eight hours. There was a decrease in the metabolic rate averaging 54.5 per cent of the pre-iodin level in 3.3 days. Clinical improvement consistent with this drop in metabolism was noted. The iodin remission secured in this way is the same as that observed when iodin is administered orally over a longer period of time. The efficacy of this form of treatment in cases of storm and those with gastrointestinal symptoms is discussed.

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GASTROILEOSTOMY AND GASTROILEAC ULCER*

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THE operative treatment for gastric or duodenal pathology presents many perplexing problems and gastroenterostomy is often done as the least radical and most successful manner of alleviating otherwise chronic and troublesome pathology. This procedure, however, meets with so high a proportion of failures even in skilled hands, that it is well to investigate those factors which individually or collectively defeat the purpose of the operation.

Failure to effect a cure or obtain relief after gastroenterostomy is due to various causes, some of which are within the power of the surgeon to cope. It is possible to define four main classifications: mechanical, chemical, infectious and neurogenic.

1. *Mechanical.* These consist mainly of errors in surgical technique and judgment amenable to correction. Among these may be listed those factors directly involving the anastomotic site, such as, improper selection of a site on the anterior or posterior stomach wall; the direction of the stoma; the choice of a proper region so as not to utilize too long or too short a proximal loop; kinking of the loop of the jejunum by adhesions or other factors; rotation of the jejunum on its long axis; creation of too small or too large a stoma; placement of the stoma not near enough to the greater curvature. Failure may also occur when the rent in the transverse mesocolon is not sutured to the stomach wall at a proper distance from the anastomosis; when the opening in the mesocolon is too small or too close to the transverse colon; and when the margins of the rent in the mesocolon are not inverted. Postoperative adhesions to the raw areas created by trauma or infection are responsible for a large percentage of untoward results. Less frequently factors not directly involving the anastomotic site may have a bearing on the ultimate outcome, such as, herniation of the jejunum through the mesocolic opening; mesenteric compression of the duodenum; a prolapsed or abnormally long duodenum, and gastroptosis, which may cause an axial rotation about the anastomosis. In passing it is worth noting that errors in the technique of operation are not too infrequently a source of future embarrassment, viz: the error of using non-absorbable suture material, which may interfere with proper healing; improper application of clamps to the stomach and jejunum, favoring development of marginal ulcers; inadequate approximation of the corresponding layers of stomach and jejunum; trauma introduced locally by careless handling; strangulation of tissue by unduly tight or leakage due to loose suturing.

2. *Chemical.* A most frequent source of failure is the development of a marginal ulcer at the anastomotic site. While this may often be ascribed to gastric hyperacidity, other mentioned factors may act as contributory causes for the formation of a "locus minoris resistantiae," which may act as a nidus for future ulcer formation. It has been agreed by different observers that when the jejunum or ileum is exposed to the highly acid gastric contents the mucosa of this part of the intestine is less resistant than that of the duodenum, which is normally protected by alkaline secretions.

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Mann and Bollmann have proved that when experimental anastomosis is established between the stomach and small intestine, the further away the loop of the small gut selected is from the duodenojejunal angle, the more apt is ulceration of the intestine to follow. They have further shown that ulcers thus formed are resistant to healing but will close after the gastric juice is shunted from the ulcerated area. Finally, the relationship between gastric hyperacidity and ulcer formation is only too well known by clinicians to be more than mentioned.

3. *Infectious.* One cannot stress too strongly the elimination of foci of infection preoperatively, such as, infected teeth, tonsils and sinuses, as they may not only interfere with healing of the original ulcer but may also predispose to the formation of a marginal ulcer. Preoperative gastric preparation by lavage, so as to insure as clean and as empty a stomach as possible, will help eliminate infections due to purely local causes. Proper aseptic technique at the time of operation and hemostasis of gastric and jejunal vessels are of paramount importance in preventing postoperative hematomata at the anastomotic site, with infection and subsequent marginal ulcer formation. Edema about the anastomotic site secondary to infection at that area is often overlooked as a cause of interference with function of the gastroenterostomy stoma.

4. *Neurogenic.* In 1841, Carl Rokitansky described several types of ulcerative processes, occurring in both children and adults, which he attributed to "a diseased innervation of the stomach, owing to a morbid condition of the vagus." Since that time, the conception of the interrelationship between peptic ulcer and disordered vagal stimulation has gained ground in so many quarters as to make observers feel that this factor perhaps may be responsible for the formation of a large percentage of ulcers. It has been demonstrated in laboratory animals that erosions can be produced by sectioning or stimulating either or both vagi, above or below the diaphram and also that stimulation or division of the splanchnic nerves or coelias plexus, which give rise to the sympathetic nerve supply of the stomach, causes a similar effect. Whether overaction of the vagus or underfunction of the sympathetic nerve supply is the motivating factor is still a moot point; but suffice it to say that some disturbance of the neurogenic gastric mechanism is evidently at work in impairing gastric function. The clinical application of this hypothesis has been admirably summed up in the following statement of Cushing's:[1]

> It may easily be that high strung persons who incline to the form of nervous instability classified as parasympathetic (vagotonic) through emotion or repressed emotion, incidental to continued worry, anxiety and heavy responsibility, combined with other factors, such as: irregular meals and excessive use of tobacco, are particularly prone to have chronic digestive disturbances with hyperacidity often leading to ulcer, effects wholly comparable to those acutely produced by irritative lesions experimentally made anywhere in the course of the para-sympathetic system from the tuberal center to its vagal terminals.

It is only a step further to assume that the persistence of this neurogenic factor may readily defeat any attempt at surgical palliation. Indeed, some operators have severed the vagus as it lies on the gastric wall at the cardia to overcome this influence, with varying success.

One must emphasize that while any or several of these factors may act as causes for failure, it is the coexistence of these causal elements that must be considered in the study of each individual case.

It may be seen from this summary that the operation of gastroenterostomy for gastroduodenal ulcer disease may fail its purpose for either of two reasons: (1) that the factors which were in operation prior to the enterostomy have continued despite the surgical procedure; and (2) that new factors both avoidable and inavoidable have been introduced by the procedure.

A rather unusual avoidable cause of failure, not as yet mentioned, is the unintentional performance of the startling procedure of gastroileostomy through error. Although the literature to date reveals only 13 reported cases, to which we would like to add 3, we feel that there are possibly many more cases which remain unmentioned, because: (1) patients may remain a symptomatic for various periods of time; (2) the reluctance of surgeons to report this phenomenon, either as an operative or postmortem finding; and (3) non-recognition of the syndrome either clinically or radiographically.

The first report of such a condition was made by Martin and Carroll[9] in 1915, the case of a negress, aged twenty-six years. She had been operated two years previously for ulcer symptoms, a gastroenterostomy apparently being performed. A second operation revealed a gastroileostomy about twenty inches from the ileocecal valve, and a third operation for disconnection of the anastomosis was followed by an uneventful recovery. The curious feature of this case was that in the interval between the first and second operations the patient's nutrition had been fairly well maintained, showing that the pylorus had remained patent and that the small intestines had continued their physiological function in spite of the partial sidetracking. Mercur[3] in 1917 reported the case of a female aged thirty-eight years, who originally had a gastroenterostomy performed in 1913; exploration in 1916 revealed an anatomosis between the stomach and ileum for a distance of six inches. Restoration of normal continuity effected a complete cessation of symptoms. The authors also cite a case operated on by Judd at the Mayo Clinic in 1912 of a male who had had a gastroenterostomy one and a half years ago, and in whom an anastomosis between the stomach and ileum within five inches of the ileocecal valve was found. The patient eventually died of acidosis. Klein[4] in 1926, briefly mentioned the accidental finding of a gastroileostomy in an individual operated by Berg, who was the first to note the presence of an ileac ulcer opposite the stoma.

The most comprehensive contribution to this subject was made by Rivers and Wilbur[2] in 1932. They reported a series of 9 cases of gastroileostomy, all proved either roentgenologically or by operation. Exploration and disconnection, with or without further treatment of the original ulcer, was performed in all but one case. It is interesting to note that a gastroileac ulcer was demonstrated in only 2 of these cases, and gastroileitis in a third.

To summarize, 13 cases of accidental gastroileostomy have been reported in the literature to date, with the coincidental findings of gastroileac ulcer in 3, and a gastroileitis in one.

The rather infrequent occurrence of an ulcer at the anastomotic site is of interest in the light of the work done by Mann and his co-workers[5–8] on the experimental production of ulcer in animals. His procedure first consisted in severing the pylorus and closing off the duodenal end. The first part of the jejunum was then sectioned and the distal of the two ends anastomosed end-to-end to the pylorus, the proximal end being anastomosed side-to-side to the terminal portion of the ileum. In this way, all duodenal secretions were drained from the pylorus and the jejunum received unneutralized gastric contents. He found that in every case thus treated, an ulcer formed between ten days and three months, just distal to the suture line, lateral and posterior to the long axis of the intestine, that this ulcer was grossly and microscopically similar to human ulcer and underwent similar complications; and that the ulceration healed only if the anastomosis was unhooked and the mucosa thus protected from gastric contents, or if the duodenal secretions were drained back over the ulcer. He concludes that hyperacidity and lack of neutralization by duodenal secretions are probably the greatest factors in ulcer production and that as fast as regeneration of mucosa occurs, it is destroyed by the acidity of the gastric contents.

The clinical symptomatology of gastroileostomy is usually sufficiently typical to establish a diagnosis soon after a surgical procedure for ulcer symptoms. In practically all cases diarrhoea sets in almost immediately after operation; is lienteric in character and is unaccompanied by blood, mucous or pus. The stools are most frequent after meals and may vary in size and number. Loss of weight is more or less variable, depending, as has been mentioned, on the patency of the pylorus and the ability of the sidetracked small intestine thus to maintain nutrition. However, in practically every case nutrition is at least moderately impaired. While gastroileostomy per se may not be productive of abdominal pain, the onset of the gastroileac ulcer is always accompanied by some degree of discomfort. It is differentiated from the original ulcer pains, which may persist after the operation, by the change of symptoms either in severity or location, migration to the lower abdomen being most frequent. Nausea and vomiting are present in most cases, usually becoming more pronounced than that previously present or aggravated at a short time following operation. The presence of lower intestinal contents in the vomitus is, of course, diagnostic.

The determination of gastric acidity is usually valueless, as most cases show either normal or reduced figures. Radiography, in conjunction with fluoroscopy, is typical and may establish a diagnosis in doubtful cases; the barium meal may be seen to pass into the enterostomy loop and by careful study may be traced through the ileum into the cecum and ascending colon. The importance of detailed and painstaking study cannot be too highly emphasized, since the tract between the stomach and ileum may frequently be obscured by other loops of gut similarly filled with barium. In one of our cases, we were fortunate in securing a roentgenograph clearly demonstrating the passage of the opaque meal from the stomach into the ileum and cecum.

In the following presentation of cases, these mentioned features of the syndrome can be traced throughout.

CASE REPORTS

Case 1. The patient, M. C., a male Italian American, aged twenty-seven years was first treated by the author in March, 1933. Prior to that, he had been originally observed in an Out Patient Department in November, 1931, giving a history of intermittent epigastric pain after meals for the past twelve years, becoming more severe lately, relieved by alkalis and food and aggravated by fried foods. Gastric analysis showed a free acidity of 80 and a total of 90. As no relief was obtained by treatment with alkalis and diet, the patient was hospitalized in December, 1931. After a stay of one day, the patient signed his release and returned to the clinic, but continued to complain of increasingly severe symptoms. A gastrointestinal series done in January, 1932, showed an irregularity of the duodenal bulb. The patient was readmitted at the end of January, 1932, with the story that since his previous admission the attacks of epigastric and right upper quadrant pain had become almost constant and knife-like. Gastric analysis at this time showed a free acidity varying between 30 and 70 and a total from 45 to 90. In February, 1932, a gastroenterostomy was performed at which time the surgeon reported two prepyloric ulcers surrounded by a hard indurated area on the anterior stomach wall. Operative recovery was without mishap, and the patient was discharged with a disappearance of his former complaints. Several months after leaving the hospital the man began to experience attacks of pain in the right hypochrondiac region and right iliac fossa, coming on twice daily, throbbing in character and lasting about twenty minutes. This was followed by cramp-like epigastric pains, lasting about one-half hour, not accompanied by nausea or vomiting. Another gastric analysis showed a free and total acidity of 35, and a trace of blood. A gastrointestinal series showed a persistent irregularity of the duodenal bulb. It is important to note here that an apparent reduplication of the hepatic flexure was also reported. In light of the later findings, this was probably the loop of ileum between the stomach and colon. The patient was admitted to the Cumberland Hospital in March, 1933, on the gastrointestinal surgical service of the author

complaining of pain in the epigastrium. Stool, urine and blood examinations were negative. At operation, a week later, a gastroileostomy was found between the posterior stomach wall and terminal ileum, five inches from the ileocecal valve. An indurated mass, the size of a hen's egg was present at the anastomotic site, careful dissection of which revealed a gastroileac ulcer. The stoma was markedly narrowed by this ulceration, edema and scarring. The enterostomy was undone, ulcerated margins of ileum and stomach excised and normal continuity of stomach and ileum was reestablished by plastic procedures. Because the ulcer originally present had apparently healed and in view of the patient's poor preoperative condition, no further surgery was undertaken. Recovery was uneventful and the patient was discharged in April, 1933, fourteen days postoperatively, with no complaints. He was symptom free for six months and then began to have epigastric distress after meals, belching, occasional vomiting and loss of weight, necessitating admission to Beth-El Hospital in May, 1934, for a second time under the author's care. Operation at this time showed satisfactory healing of the scars of the stomach and ileum with no stenosis of the latter. An extensive ulcer involving the first and second parts of the duodenum was present, the surrounding edema extending to the region of the common duct and head of the pancreas. A posterior gastroenterostomy was performed, it being deemed inadvisable to resect the stomach and duodenum because of the location of the ulcer. Recovery was uneventful and the patient was discharged in two weeks. Since then he has gained weight and has experienced none of his former symptoms. He is on an unlimited diet and is able to work continuously. When seen in September, 1935, he had no reoccurrence of symptoms.

Case II. A male, C. B., aged twenty-six years, Irish-American, when seen in 1934 revealed the following past history, obtained from the institution where he was first observed and treated. In 1929 he began to complain of intermittent post-prandial abdominal pain, relieved by vomiting and food ingestion. He first applied for treatment at the Out Patient Department in 1932. Gastric analysis at that time showed a free acidity of 50 and a total of 75. A gastrointestinal series revealed a small annular narrowing at the pylorus, probably due to ulcer, and intestinal hypermotility. After ineffectual ambulatory treatment with alkalis, belladonna and bland diet, the patient was

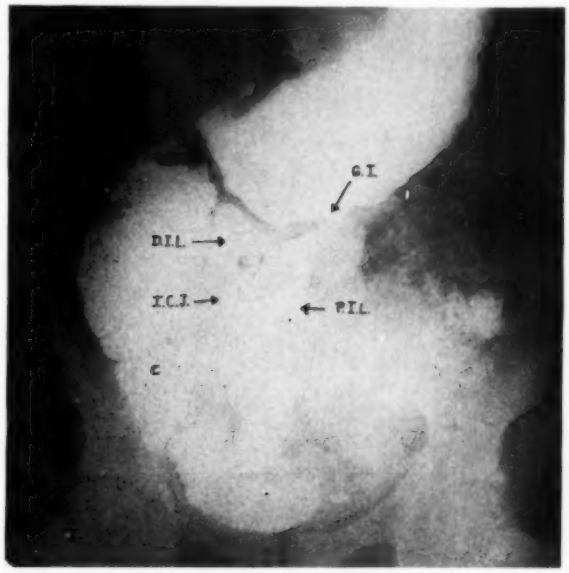

Fig. 1. U. Ulcer. G.I. Gastroileostomy. D.I.L. Distal ileal loop. I.C.J. Ileocecal junction. P.I.L. Distended proximal ileac loop. C. Cecum.

hospitalized in February, 1932. Operation in March confirmed the presence of a scarred indurated area near the pylorus and a posterior gastroenterostomy was apparently performed. Recovery was marked by upper abdominal pain, radiating to the thorax. He was treated for a pneumonic infection, which was not verified by an *x*-ray film. The patient was finally discharged with complete cessation of his former symptoms. The patient remained in fair health for the next nine months, until November, 1932, when he noticed a recurrence of upper abdominal pain, relieved by food, and daily vomiting. An *x*-ray series taken in April, 1933, revealed an irregular duodenal bulb surrounded by adhesions and twenty-four hour filling of the cecum and the lower colon. The course of the anastomosis previously performed was apparently not visualized.

Due to persistence of these symptoms, the patient was readmitted at that time, with physical findings of epigastric and McBurney tenderness, and an impression of marginal ulcer. Gastric analysis showed a free acidity of 10 and a total of 20. Stools showed the presence of blood in two specimens. Blood count and chemistry were essentially normal. The Wassermann was negative. The patient was placed on symptomatic treatment for the next two weeks,

but continued to complain of para-umbilical distress and vomiting to a somewhat lesser degree. He was eventually discharged with a

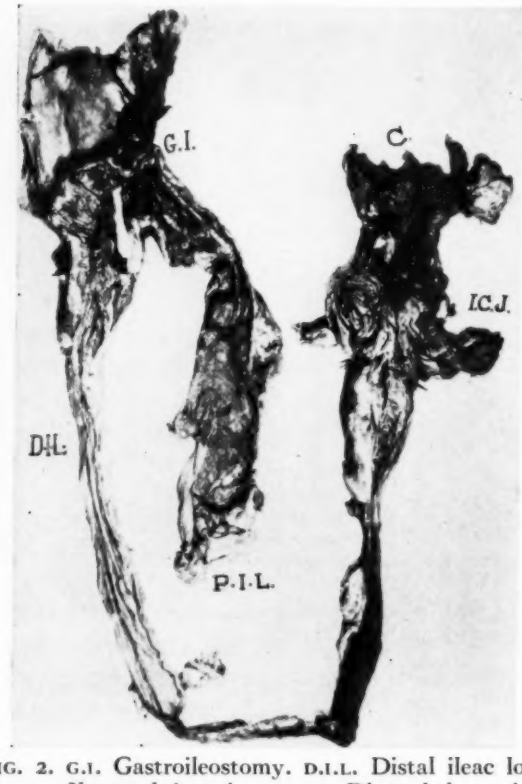

Fig. 2. G.I. Gastroileostomy. D.I.L. Distal ileac loop. I.C.J. Ileocecal junction. P.I.L. Distended proximal ileac loop. C. Cecum.

moderate subsidence of his previous complaints and a diagnosis of recurrent peptic and marginal ulcer.

The man continued to complain at intervals of severe right upper and lower and left upper quadrant pain after meals, and dull constant distress to the right of the umbilicus and across the hypogastric region. Vomiting was partially controlled by a selected diet. At this time he came under our observation and was admitted to the Beth-El Hospital in May, 1934 with physical findings of upper abdominal spasticity and tenderness in the right upper and both lower quadrants. His weight at that time was 98 pounds. His blood study showed a moderate secondary anemia. Examination of the urine was negative. The feces showed no undigested food, which is important in view of the operative findings. The patient also claimed to have lost a moderate amount of weight. In view of the *x*-ray findings (Fig. 1) and clinical symptoms a preoperative diagnosis of gastroileostomy was made. Operation a week following admission revealed that a gastroileostomy was present about eight inches proximal to the ileocecal valve. The stoma was narrowed to admit only one finger, with a moderate degree of induration, but no ulceration. The scar of an ulcer was found on the anterior portion of the duodenum. The appendix was chronically inflamed. Extensive adhesions involving the omentum, colon and small intestine were separated, the anastomosis was divided and the ileum was repaired to widen the lumen. A subtotal gastrectomy, Polya-Hoffmeister, was performed. The appendix was involved in extensive adhesions and was removed. Recovery was uneventful, the patient being discharged fourteen days after operation. Since then the patient's weight has increased to 135 pounds on an unlimited diet and he has been free of all gastrointestinal complaints. He has been able to return to work as a seaman, and when last seen in September, 1935, had no complaints.

Case III. This was the case of a male, aged sixty-three years, the autopsy of which recently came to our attention as he was not treated by the authors. For the past six months, this individual had complained of a sense of epigastric fullness, watery regurgation from the stomach and marked loss of weight. *X*-ray pictures taken a week before admission showed a gastric malignancy at the pylorus. On admission a hard, irregular, non-movable mass was felt in the epigastrum. Operation confirmed the presence of neoplasm of the stomach and a partial gastrectomy was done. The patient's death several days later was attributed to cardiac and circulatory collapse. Autopsy revealed a gastroenterostomy, the stump of the stomach being anastomosed to the ileum about eight inches from the ileocecal valve. The accompanying photograph illustrates this condition (Fig. 2).

From the foregoing case histories it may be gathered that the syndrome of gastroileostomy can be readily suspected. The persistence of abdominal symptoms, usually somewhat altered in character and location; the alteration of the type of stools; the marked or moderate impairment of nutrition and the reappearance of nausea, vomiting or both, are all evidence of an error in surgical procedure. However, only roentgenological demonstration

of the faulty anastomosis can definitely establish a diagnosis of gastroileostomy.

Under the circumstances, it is obvious that whatever means the surgeon has at his disposal for avoiding this operative error should be utilized.

As in any other surgical procedure on the gastrointestinal tract an absolute identification of the anatomy is essential. It is important that the transverse mesocolon be brought into sight and its under surface identified along with the ligaments of Treitz and the duodenojejunal junction. This visualization excludes all methods of selection of the jejunal loop, which depend on the directional course of the dorsal mesentary which may be twisted in handling; the fixity of the selected loop, as demonstrated by the cases cited where the loop was close to the ileocecal junction; or methods which depend upon the selection of the small intestinal loop by the character of the vascular pattern in the mesentery. Visualization of the inferior surface of the transverse mesocolon not only aids in the identification of the proximal jejunum, but also is essential in the selection of a site for the opening in the mesocolon and for the mobilization of the proximal jejunum loop, as recommended by Lahey, so as to avoid kinking or torsion of the anastomotic site in the performance of gastroenterostomy or resection.

SUMMARY

1. The causes of failure following gastroenterostomy have been classified and analyzed under four headings: (a) mechanical, (b) chemical, (c) infectious and (d) neurogenic. A further division of these factors into those operating in spite of, and those because of, the procedure has been made.

2. An unusual avoidable cause of failure is the unintentional performance of gastroileostomy through error with the resulting formation of a gastroileac ulcer. The clinical and radiographic recognitions of this syndrome have been stressed. The appearance of this entity in the literature to date has been traced.

3. Two such cases of gastroileostomy have been described, one presenting a gastroileac ulcer, with recovery of both patients following operative correction. A third case which was found at autopsy has also been mentioned.

4. Methods of avoiding this surgical mistake have been suggested in an endeavor to eliminate similar failures.

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ANALYSIS OF 100 CONSECUTIVE THYROIDECTOMIES

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THE term goitre, meaning enlargement of the thyroid, is used very loosely. The following 100 goitre patients are from Long Island and vicinity, known as part of that great watershed of the endemic goitre belt in the Western Hemisphere, but I do not mean to convey the impression that the lack of iodine in this watershed area is entirely the causitive factor. I have always been mindful of the hereditary diathesis and autonomic imbalance which exists in these individuals as an associated factor in this disease. Hence, the result in this group of cases, if this is true, should correspond to other clinics in this geographic area. This parallelism can be easily demonstrated.

Thyroidectomy as the best treatment has been challenged by some; but in the last decade the challengers have become fewer and more have been convinced of the good results obtained by the partial surgical removal of the thyroid gland. Here again I do not mean to convey the impression that surgery is the only form of treatment, in a selected small percentage roentgen ray and medical treatment are indicated.

In this series of 100 consecutive thyroidectomies performed over a period of six years, I will endeavor to demonstrate accurately the results by comparison of pre and postoperative condition of patients. Sixty of this series have been followed to date. The boundary line between the slightly toxic and non-toxic cases is frequently difficult and personal; confusion still exists in the differentiation between toxic adenoma and exophthalmic goitre and parallel to this the pathology of the gland is mixed and cyclic in nature.

INDICATION FOR OPERATION

1. All toxic patients young or old, before severe injury occurs to the heart and circulatory system, who must return to an early useful economic life.

2. When goitre is unsightly and regarded by the patient as a morbid symptom.

3. All patients with organic damage as indicated by persistent hypertension, cardiac irregularity, alterations in function of the liver or in pigmentation of the skin.

4. When the gland suggest malignant degeneration.

5. Pressure symptoms.

STATISTICAL ANALYSIS

1. *Number:* Of 100 cases, 60 have been followed to date, some as long as six years.

2. *Age:* The youngest patient was fourteen years, the oldest sixty-nine years, giving an average of thirty-nine years. There were 29 cases under thirty-five years; 71 cases thirty-five years and over.

This division at thirty-five years is quite important as was first demonstrated by Trousseau in his clinical lecture published by the Sydenham Society. In the younger group exophthalmus is more frequent; in the older group cardiac pathology with cardiac decompensation, auricular fibrillation, frequently complicated by essential hypertension, diarrhea, pigmentation, are more noticeable and they respond much less to iodine medication.

3. *Sex:* There were 4 males and 96 females.

4. *Diagnosis.* (a) *Toxicity.* 68 were unquestionably toxic, the remaining 32 included questionably toxic goitre, carcinoma, Riedel's struma, cysts, etc.

(b) *Associated Conditions.* Auricular fibrillation 3, myocarditis and valvular disease 14, hypertension 7. Not of thyroid origin: fibroid uterus, chronic bronchitis, duodenal ulcer, healed tuberculosis, ovarian cysts.

5. *Symptoms* in order of frequency. The predominating or major symptoms: nervousness, palpitation, asthenia, tremor, loss of weight and exophthalmus.

The minor symptoms: dyspnea, diarrhea, sweating, dysphagia, dysphonia and pigmentation.

(a) *Nervousness* was found to be present in 93 per cent of the cases and consisted of hysterical manifestations, sense of a driving power, unexplainable uneasiness; in 2 cases bordering on a maniacal state requiring careful supervision and control.

Improvement in this nervousness began in the first month postoperative. Symptom remains occasionally as a residual condition after operation. In none was nervousness made worse by the operation, and improvement in about 80 per cent to 90 per cent.

(b) *Palpitation* present in 85 per cent, consisted of a pounding sensation in the cardiac region and along the great vessels of neck, aggravated by exertion or mental disturbance. Improvement in this symptom began in the first three months, vanishes in about 80 per cent to 90 per cent. Occasionally, however, residual palpitation in greatly diminished form may persist.

(c) *Asthenia* present in 86 per cent of the cases, consisted of utter exhaustion, aggravated by any exertion, or by the ordinary requirements of life's function. It is probably the most persistent and frequent residual symptom after operation.

(d) *Dyspnea* present in 60 per cent to 70 per cent before operation, improvement begins one to three months after operation but frequently is delayed, probably depending on the recovery of normal heart function.

(e) *Tremor* present in 57 per cent, most easily observed when hands are outstretched and fingers separated, consists of fine or coarse types, usually disappears within three months. Sometimes remains as a residual symptom with but in greatly diminished severity.

(f) *Loss of weight* occurred in 50 per cent of the cases prior to operation, with an average loss of 11 pounds. About 60 to 70 per cent gained after operation, average gain being about 15 pounds. Excessive gain in weight, low basal metabolism, doughy dry skin, puffiness of face, especially lower eyelids, loss of energy, menstrual disorders and signify hypothyroidism and was observed in 5 per cent following operation. Small doses of thyroid rectified this condition and after some time hypertrophy of the remaining gland was able to carry on body function usually without further medication.

(g) *Exophthalmus* was present in 30 cases or 34 per cent.

The clinical observation of Trousseau made many years ago is well demonstrated. It is more frequent in the young group.

Age	Total Number	Exophthalmus	Per Cent Exophthalmus
Below 35 years.....	38	19	50
Above 35 years.....	62	14	36

No measurements of the degree of exophtholmus were made but in general although many of these cases presented this persistent residual symptom but to a lesser degree and being unilateral in 2 patients, greatly disfiguring the patients, especially abnoxious in young women.

(g) *Dyspnea and dysphagia* could not be accurately ascertained but were present with great frequency.

(h) *Diarrhea* occurred in 3 cases, all in the group above thirty-five years.

(i) *Pigmentation* occurred in a female patient, aged forty-nine years with auricular fibrillation.

6. *Etiology*. The etiology of goitre is not clearly understood and the primary cause probably does not reside in the thyroid gland; but we know that there is an increased activity of the gland structure manifested by increase in the number of the acini cells showing increase in mitochondria, staining deeply and paral-

lel to this process we have an increase in thyroxin which is absorbed freely by the blood and lymph stream. On careful analysis the following were revealed as precipitating factors.

	Number Cases
(a) Sex—epoch	1
(b) Psychic insult, pregnancy and prolonged hard labors and associated factors	3
(c) Heredity	7
(d) Focal infection, teeth, tonsils	17
(e) Unknown, which is the predominating number	72

7. *Laboratory and Subjective Data.* (a) *Palpable viscera* is of interest and is found more frequently in the older group.

	Cases
Liver palpable	3
Spleen alone	1
Spleen and liver	1

It represents a sympathetic hyperfunction of the glandular organs and is an indication for operation.

(b) *Fever on Admission.* There were 8 cases with a maximum temperature of 102°F. which responded within a few days, usually was present in some of the cases falling in the group of doubtful surgical risks.

(c) *Blood pressure* was elevated in 25 patients; 14 of these were in the older group of which 50 per cent had a hypertensive type, primarily due to vascular disease and the other 50 per cent exhibited the hypertension found in thyrotoxicosis with a large pulse pressure. Of the 11 younger patients representing 30 per cent of this group, the typical elevated blood pressure of thyrotoxicosis was found with the usual marked increase pulse pressure.

(d) *Basal Metabolism.* The average rate on admission was +47 per cent, highest +108, and the lowest was +4, with the average rate before operation +22, highest +58 and lowest +3. The average postoperative rate was +5. Some of the cases were quite refractory to treatment in attempting to lower the basal metabolism and incidently improving the general condition of the patient; striking exceptions exist, patients may have severe manifestations of the disease with slight elevation of metabolism. The basal metabolism rate may remain unchanged despite good progress. Gain in weight, lower pulse rate and general well being of patient are quite important, and the patient must be considered as a whole, to judge operability.

(e) *Pulse rate* will be better shown graphically, suffice it to say that the rate fell progressively to normal in most cases. Follow-up results show decrease to normal in about 80 to 85 per cent of the cases.

(f) *Preoperative Heart Finding.*

1. Many thyroid patients complain of severe palpitation and precardial pains but the heart is in good condition; this is due to the disequilibrium of the neurovegetative system.

2. Cardiac form of Basedow's disease or cardiothyrosis with cardiac dilatation, auricular fibrillation and circulatory insufficiency.

3. Heart previously damaged by rheumatism or lues then added hyperthyroidism and in those patients results are not very good.

(g) *Pathology.* The simplified classification of the American Goitre Association is used and this reported group fall into:

	Cases
1. Toxic goitre.	
(a) Diffuse or Graves disease	31
(b) Nodular	37
2. Non-toxic.	
(a) Nodular	24
(b) Diffuse	4
3. Malignancies	2
4. Thyroiditis	1
5. Riedel's struma	1

8. *Histology.* (a) *Graves Disease.* The gland is usually uniformly enlarged but occasionally may be of normal size.

Histological the pathology is that of a diffuse cellular metaplasia. The eqithelium is tall columnar, mitochondria is prominent, nuclei are large, irregular with occasional mitotic figures. The acini may be increased in number and size with infolding or budding; the colloid is scanty,

watery, staining very faintly with vacuolization at the margins, the stroma is scant with some lymphoid cell infiltration.

(b) *Toxic Adenoma.* The gland is irregularly enlarged, microscopically we have the same picture as described in Graves disease but this process is confined to one or more areas and is encapsulated giving rise to one or many tumors, the genesis of which is still a debated question; or we may and frequently do have a mixed pathology, known as toxic adenomatosis, or in sections, may have degeneration of adenomas with accumulation of mucous or hemorrhage resulting in cystadenomatosis.

(c) *Non-toxic Nodular Goitre.* The gland is irregularly enlarged, may attain enormous size with encapsulated adenomatous nodules of varying size throughout the gland structure. It is probably the end result of the toxic adenoma, and may have an accumulation of large amount of colloid, then known as colloid adenoma; this type is very prone to degeneration and hemorrhage, leading to cyst formation. Calcification is a common occurrence in this type of goitre.

(d) *Diffuse Non-toxic.* The gland is uniformily enlarged, firm and may attain large size. The acini are usually widely separated by a peculiar material resembling colloid but of lighter staining character, with occasionally small cells which may undergo fibrosis. There are large thin walled vessels with frequent but unexplained hemorrhage in the resting gland.

(e) *The Nodular Toxic; Nodular Non-toxic; Diffuse Non-toxic.* The histological pathology is merely a matter of preponderance of the cellular activity with corresponding clinical symptoms.

(f) *Thyroditis.* This inflammatory pathology resembles any other inflammation with edema, engorgement of the vessels, infiltration of the white cells and may go on to abscess formation.

(g) *Riedel's Struma or Woody Thyroditis.* The gland is extraordinary hard, its borders poorly delineated and firmly adherent to surrounding structures.

Microscopically. In the early stage are seen numerous lymph follicles with prominent germ centers and a diffuse infiltration of round cells which later are replaced by dense sclerotic tissue. The parenchyma degenerates, the cells lining the acini become detached, fusing around drops of colloid, resembling giant cells. Irregular cellular hyperplasia may persist leading occasionally to faulty diagnosis of carcinoma.

9. *Position of Goitre.*

(a) Substernal	10
(b) Retrotracheal	8
(c) Substernal and retrotracheal	7
(d) With aberrant thyroid tissue	4
(e) Not remarkable	7

10. *Postoperative.*

(a) Reactions were mild in 75 per cent, moderate in 20 per cent and marked in 5 per cent.

(b) Treatment consists of sedatives, as morphine, luminal, phenadorn, bromides; diet must be forced, milk, fruit juices and cereals, ice cream are well received. When crisis is encountered glucose and insulin are used intravenously slowly and in large quantities. Tetany is treated with calcium, parathyroid hormone and lactose.

11. *Convalescence.* In the majority, the basal metabolism falls to normal, tachycardia lessens and a large proportion of the minor symptoms disappear, a feeling of well being returns rather promptly. Some of the persistent residual symptoms noted are exophthalmus, which was unilateral in 2 cases, asthenia, nervousness and tremor but to a lesser degree.

Patients should not resume usual social and economic life until two to three months after operation.

12. *Recurrences* are usually due to insufficient removal of gland tissue and may require secondary operation but aberrant thyroid tissue might be the cause. Radiotherapy frequently helps in selected cases. Myxedema may result and manifests itself if too much thyroid tissue is removed, or removal of Riedel's struma or non-toxic colloid goitre. It is usually manifested by dyspnea, edema, lack of energy, enlarge-

ment of the liver, passive congestion of the lungs with dilatation of the heart and low basal metabolism.

Treatment. Thyroid extract from gr.s.s. to gr.11 daily. Basal metabolism should be kept at about −15 per cent.

13. *Post-operative Follow-up Condition.* Of the 100 patients operated 60 were followed to date, the time after operation varying from three months to six years. The following response to a questionnaire and a personal interview was obtained:

Fine	24	96 per cent
Good	20	
Improved	13	
Very little improved	0	
Not improved	1	(died subsequently of cancer of larynx)
Not reported	2	
Total	60	

The above results recast may be represented as follows:

	Per Cent
Improved	57 = 95
Not improved	1 = 1.66
No records	2 = 3.33

In the interim postoperative, 2 reported uneventful appendectomies and 4 normal pregnancies; 4 developed hypothyroidism, successfully treated by thyroid; 1 developed auricular fibrillation despite removal of gland, another pulmonary tuberculosis; 1 expired two years postoperatively from hypertensive cardiac disease.

By graphic illustration of these cases the progress of those patients possibly can be more easily assimilated.

WEIGHT (PREOPERATIVE 50 PER CENT LOST). WEIGHT (POSTOPERATIVE)

	Number Cases	Per Cent
Gained	48	8
Stationary	6	10
Lost	5	8
No record	1	2
Total	60	

PULSE RATE

	Admission	Preoperative	Discharge	Follow-up
Average	97	89	84	82
Highest	130	120	120	100
Lowest	70	70	70	70

BLOOD PRESSURE

Age	Number Cases	Total Hypertensions	Thyroid Hypertensions	Essential or Primary Hypertension
Above 35 years	71	14	7	7
Below 35 years	29	11	11	0

PREOPERATIVE SYMPTOMS

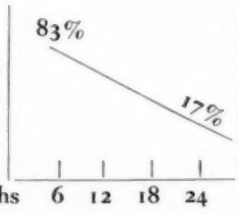
Symptoms	Number Cases	Per Cent Frequency
Nervousness	93	93
Palpitation	85	85
Asthenia	86	86
Tremor	57	57
Loss of weight	50	50
Exophthalmus	34	34
Dyspnea	27	27
Diarrhea	3	3
Thyroid tumor	73	73
Dysphagia	5	5
Dysphonia	4	4
Pigmentation	1	1

EXOPHTHALMUS

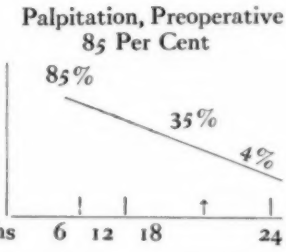
Age	Total	Exophthalmus	Per Cent of Exophthalmus
Above 35 years	71	10	15
Below 35 years	29	21	71

NERVOUSNESS

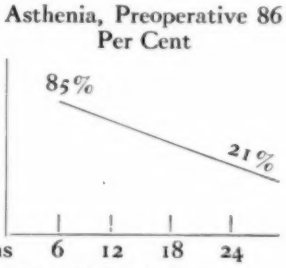
Preoperative, 93 Per Cent		Postoperative	
Absent	1	Unchanged	2
Slight	3	Less	9
Moderate	6	Much less	39
Marked	46	Absent	9
No records	4	No records	1
Total	60	Total	60



Palpitation, Postoperative	
Decreased	19
Increased	1
Stationary	1
Absent	39
Total	60



Asthenia, Postoperative	
Marked	4
Absent	15
Slight	31
Moderate	9
No record	1
Total	60



Comparative Curves on Basal Metabolism

SUMMARY

1. Indications for operation should be studied carefully.

2. Symptoms in order of frequency are nervousness, palpitation, asthenia, tremor, loss of weight and exophthalmos; and the minor symptoms are dyspnea, diarrhea, tremor, sweating, dysphagia, dysphonia and pigmentation.

3. Diagnosis of thyroid toxicity is at times difficult.

4. Preoperative treatment in toxic goitre consisting of rest, high calorie diet and Lugal's solution are absolutely necessary.

5. Free mobilization and thorough removal of sufficient gland tissue are essential.

6. Toxic crisis need energetic treatment. (a) Sixty unselected cases follow-up responses ranging from three months to six years, 84 per cent report satisfactory or complete cures. This percentage is verified by the following: (1) Gain in weight. 39 gained an average of 15 pounds, 96 per cent gained or remained normal. (2) Pulse. Average admission 97, average postoperative 82. Reduction in rate shown by 93 per cent. (3) Basal metabolic rate of plus 47 per cent, reduced to plus 5 per cent, 80 per cent showed a reduction. (4) Ability to follow their normal occupation.

CASE REPORTS

OSTEOCHONDRITIS DISSECANS ACETABULI*

TOM A. OUTLAND, M.D., F.A.C.S. AND JAMES M. FLOOD, M.D.

SAYRE, PENNA.

THE following 2 cases, representing a rare hip-joint affection, have been examined in the Guthrie Clinic during the past two years. In view of the wide difference of opinion as to the diagnosis, one probably displays considerable temerity in offering a diagnosis which can, after all, only be definitely confirmed at operation. We, therefore, first present the clinical record of these 2 patients, followed by a differential diagnosis and, finally, venture a diagnosis which we believe is substantiated by the elimination of other somewhat similar conditions and by the similarity of our cases to the only 2 cases of a condition previously recorded.

CASE REPORTS

CASE I. E. A., a white female, aged thirteen years, entered this Clinic on December 23, 1933, complaining of pain, an audible "click" in both hips and stated that the hips had felt weak for a considerable period of time. Three or four months previously the "click" had appeared first in the right hip and later in the left. This was not only apparent to the patient but had been noted by her mother also. The symptoms were aggravated by strenuous exercise, such as rollerskating, running, and the like.

Examination of the hips showed no shortening or atrophy. The hip flexion test was negative and motion full range and painless. At first, no "click" could be elicited, but after walking about the examining room, the patient was soon able to produce it. With the patient recumbent, circumduction likewise elicited the "click." It could be palpated anteriorly over the joint. It was specifically noted that it was not palpable over the trochanter and that the iliotibial band was not involved in producing the snapping of the hip. The patient noted a feeling of weakness and slight pain coincident with the "click."

Anteroposterior *x*-rays (Fig. 1) showed an irregularly shaped and sized loose body of bone density in the articular fissure of either hip, which was not alongside of the acetabulum but actually involved the superior articular surface of the acetabulum. Opposite each body was a corresponding articular defect. Oblique views (Figs. 2 and 3) even demonstrated more clearly the fact that they were detached.

Treatment. In view of the mildness of the symptoms, treatment consisted merely of bed rest for two weeks followed by gradual activation. Strenuous exercises were prohibited. Over a period of eighteen months the symptoms gradually subsided and when last seen on November 29, 1935, clinical and *x*-ray (Fig. 4) examinations were entirely negative.

CASE II. E. K., white male, aged thirty years, entered the Clinic on September 26, 1935, complaining of pain in the left hip and leg of several months duration and which was increasing in severity. He attributed his condition to flat feet, although he later "remembered" that shortly before the onset of his symptoms he had been lifting a heavy refrigerator and believed that he might have "strained" his hip.

On examination the patient walked with a moderate left limp. The spine was entirely negative. There was slight atrophy of the muscles about the left hip, averaging ½" and and a ⅜" shortening. The hip flexion test showed 20° flexion deformity. Flexion was limited to 90° and was painful when forced beyond this point. Abduction and rotation, particularly external rotation, were limited and painful. Examination of right hip was negative. Both feet showed marked pronation.

* From the Department of Orthopedic Surgery, Guthrie Clinic.

X-ray examination (Fig. 5) disclosed partially detached bodies involving the posterosuperior acetabular margins of both hips. The loose body on the right (Fig. 6) was roughly triangular in shape and appeared to be attached to the acetabulum by its apex. On the left (Fig. 7) it was difficult to determine whether the loose body was dumb-bell shaped or whether there were, in fact, two. On either side there was an articular defect of corresponding size and shape.

Treatment. Bed rest and traction were advised, to be followed by a short hip spica when the flexion deformity had been corrected. He was referred back to his family physician for treatment at home. The possibility of operative removal of the loose body was mentioned in case symptoms of incarceration should occur.

Clinical Course. Traction was tolerated only for about thirty-six hours and then removed. Another orthopedist made a diagnosis of "bursitis" which, he stated, he had seen quite frequently in golf players, later amending the diagnosis to "bursitis or periostitis." Since the symptoms persisted, the patient consulted another surgeon who sent the *x*-ray films to a consultant who suggested a bone tumor. A radiologist interpreted the films, stating that the lesion was too early to permit a definite diagnosis. Still another surgeon was asked to examine the *x*-ray plates, and opined that the condition might be an early bone tumor and suggested a moderate dose of deep *x*-ray therapy. The patient was consequently referred to a hospital for malignant disease for treatment. At present, about three months from his first examination, he is still confined to the house, although his symptoms are somewhat less severe than in the beginning.

The patient has shown gradual improvement until at the present time he has no discomforts in the left hip. About three months ago, however, he began to have trouble of a similar nature in the right hip. His symptoms were much less severe, and at the present time he is entirely free from discomfort.

DIFFERENTIAL DIAGNOSIS

In considering the differential diagnosis of osteocartilaginous bodies about the hip, eight conditions must be born in mind. Several of these bear only a superficial resemblance to the case under discussion and are included only for the sake of completeness.

1. Calcification of the ligamentum teres. According to Köhler[1] this is a theoretical possibility, although it has never been

Fig. 1. E. A., both hips, Dec. 23, 1933. Figures in lower corner of plates represent the tracings of original *x*-ray films. The loose bodies are shown in solid black in tracings.

recognized. Its position, deep within the articular fissure, should be sufficient to differentiate it from the cases under consideration. It might well be confused with osteochondritis dissecans of the femoral head.

2. Osteochondritis dissecans of the femoral head.

This is a rare condition. A rather careful review of the literature indicates that only 13 cases have been described under that diagnosis. Locking, which is a prominent symptom of the disease in its usual location, apparently does not occur frequently here. Pain, limp and deformity with ultimate traumatic arthritis and ankylosis, constitute the usual picture. Demonstration by *x*-ray may be difficult due to the fact that the loose bodies are thin and almost exclusively cartilaginous. Plates taken from various angles usually disclose them, however,[2] and again the location of

the fragments within the articular cavity differentiates them from the cases under discussion.

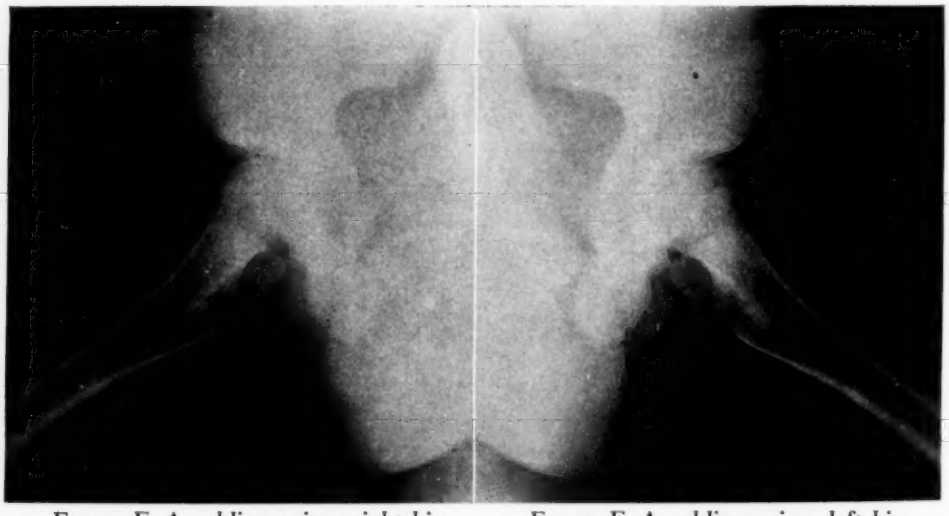


FIG. 2. E. A., oblique view, right hip.

FIG. 3. E. A., oblique view, left hip.

3. Fracture of the rim of the acetabulum complicating a dislocation or fracture of an acetabular osteophyte in the course of a hypertrophic arthritis is a possibility.

FIG. 4. E. A., both hips Oct. 5, 1935. No symptoms. *X*-ray negative.

In the first instance, the history of trauma, and in the second, the associated bone changes, make the diagnosis quite evident.

4. Inflammation and calcification of the bursa of the great trochanter.

This condition[3] is characterized by a painful swelling about the trochanter with obliteration of the retrotrochanteric hollow. The foot may be held everted to relax the outer fibers of the gluteus maximus. The hip flexion test is negative, however, and motion, except extreme internal rotation, can be performed painlessly. If calcification in or about the bursa occurs, the shadow is diffuse and irregular.

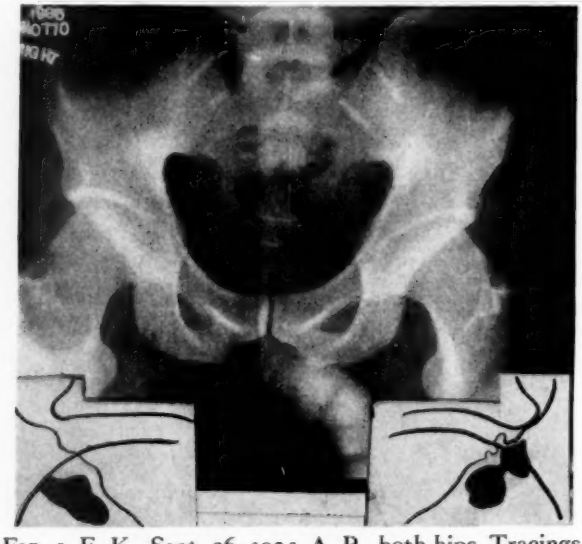


FIG. 5. E. K., Sept. 26, 1935. A. P., both hips. Tracings from original films in lower right and left corners.

The following case is quite typical, except that calcification in the involved bursa is not common.

CASE REPORT

H. D., white male, aged fifty years, entered the Clinic on November 9, 1935, complaining of pain in the right hip. This had begun on the preceding day and had increased in severity

to such an extent that he had spent a sleepless night. He had fallen down several weeks previously and struck his back. While he had been generally sore for a few days, he had no particular pain in the hip joint region. He also recalled somewhat vaguely "bumping" his hip a week or ten days before, but had suffered no immediate ill effects.

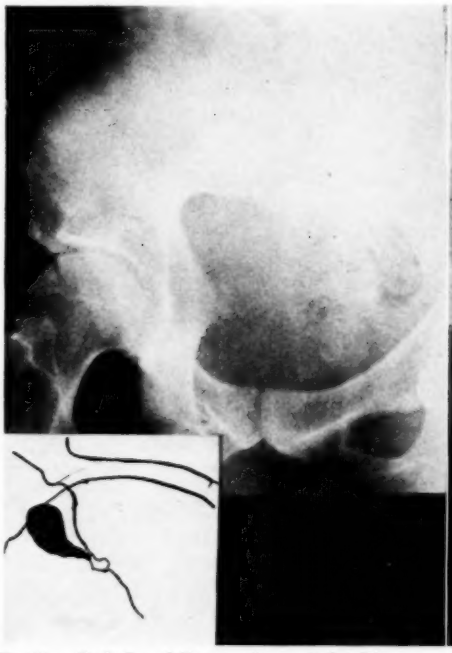


Fig. 6. E. K., slightly oblique view, right hip.

Fig. 7. E. K., slightly oblique view, left hip.

Examination showed that the patient walked with a marked limp. There was a gross tender swelling, which fluctuated, about the right greater trochanter with obliteration of the trochanteric hollow. There was no shortening and no flexion deformity. Passive motion could be accomplished carefully without pain, except extreme internal rotation which produced pain. *X*-ray examination (Fig. 8) showed the joint proper to be negative, but there was diffuse irregular calcification above the trochanter, probably in or beneath the trochanteric bursa.

Treatment consisted of bed rest and frequent hot fomentations. In three days the acute pain had subsided and medical diathermy was prescribed. This was done daily with complete relief in ten days and he returned to work.

5. Chronic deformative arthritis with plates of bone in the capsule have been described by Köhler[1] and others.

These appear as small round, oval or irregularly dense shadows which appear laterally above and internally below the acetabulum, near its margin. They are not in themselves productive of symptoms, although the accompanying arthritis may be. Figure 9 represents such a case. The patient had no symptoms referable to the hip.

Fig. 8. Bursitis with calcification. Trochanteric bursa, right hip.

6. Charcot's arthropathy.

This condition is too well recognized to require description here. The extensiveness of the process, plus the presence of neurological symptoms, should make the diagnosis apparent.

7. Os acetabuli (os cotyloideum: os coxae quartum: sesamoid bone [Moulonguet[2]]).

According to Gray,[4] Köhler,[1] Schinz,[5] Freedman[6] and others this is a normal epiphysis situated in the triradiate cartilage, which appears as a preliminary to the complete synostosis of the three component bones of the acetabulum. It was first discovered by Albinus in 1737, and may be compared to the intercalated or wormian, bones of the skull and elsewhere. Thus, according to most observers, it is a normal structure which appears in the course of the ossification of every acetabulum at about the age of seventeen years and fuses with the surrounding bones in the course of a year. Ruhle,[7] however, regards it as always pathological and mentions "late rickets" or osteomalacia as the usual cause.

Fig. 9. D. B., aged twenty-four years. Os acetabuli. "Supernumerary bone lying beside well-formed roof of the acetabulum, round as a pea, and showing uniform structure and boundaries" (Rey). No symptoms.

Roentgenographically (Fig. 10) it appears typically as a bilateral supernumerary bone "lying beside the well-formed roof of the acetabulum, round as a pea, and showing uniform structure and boundaries," according to Rey. However, it may appear in the midportion of the acetabulum,[6] in which position it is partially obscured by the superimposed femoral head. Also, it may be represented by multiple centers of ossification rather than a single one. At times it persists either singly or bilaterally, in which even, according to Köhler, it may be a symptom of an endocrine disturbance, but is not to be regarded as otherwise pathological.

Fig. 10. Calcified plaque in capsule. Patient had marked spinal arthritis and low back pain. Hip clinically negative.

Os acetabuli is not productive of symptoms, although one author (Rey) states that it generally does not induce symptoms, thus intimating that it may. It is impossible to conceive of a normal center of ossification per se producing symptoms. Theoretically, partial avulsion is possible, in which case a condition analagous to Schlatter-Osgood's disease of the tibial tubercle would be produced. However, the os acetabuli is not subjected to the constant pull of a powerful muscle group as is the former.

The 2 cases under consideration differ from os acetabuli in several important respects.

(*a*) Both patients showed symptoms, in the second case, severe enough to be disabling.

(*b*) Age; the first patient was well below the age at which os acetabuli manifests itself, and the second was well above the age at which os acetabuli is said to disappear.

(*c*) The radiographic appearance is decidedly different as the accompanying *x*-ray pictures indicate. The appearance of apparently loose bodies of irregular outline and density (particularly Case 1), with a definite articular defect of roughly similar size and shape, varies greatly from the round, even body lying along side of the normal acetabular margin and not involving the articular surface of the latter.

(*d*) The definite, painful snap which was audible as well as palpable in the first case, can be explained only on the assumption that these bodies were free or at least only partially attached, permitting slight movement and consequently slight locking during certain motions. Complete incarceration, should these bodies become entirely detached, would not be expected logically, since the space between the femoral head and the acetabulum is too slight to permit a sizable body to become impacted. Furthermore, the angle of the neck is such that the loose body would tend to gravitate toward the attachment of the capsule to the neck, rather than toward the articular fissure.

8. Osteochondritis dissecans acetabuli.

Rey[8] in 1933 reported the only 2 cases which have appeared in the literature to date.

Archer[9] has described a case which he regarded as possibly an osteochondritis dissecans of the acetabulum and suggests that writers have been mistaken in diagnosing similar cases as aberrant centers of ossification.

The symptoms described by Rey and the *x*-ray appearance simulate very closely those of the 2 patients presented here. Both of his cases were unilateral, but he states that it is conceivable that the sound joint might later be involved.

He mentions trauma as the probable causative factor.

Treatment in his first case consisted of application of a short spica followed later by a night mold when the pain had subsided largely. In his second case, due to the severity of the symptoms, operative removal was attempted but since this could not be accomplished without undue damage to the joint, operation was discontinued. He believes that resort to surgical removal should be done only if symptoms of incarceration appear.

In view of the important differences from os acetabuli detailed and in view of the similarity to the 2 previously described cases, we believe that the 2 cases herein presented represent 2 more cases of osteochondritis dissecans acetabuli.

SUMMARY

1. Two cases of painful hips in which *x*-ray examination disclosed loose bodies are presented.

2. The differential diagnosis of osteocartilaginous bodies about the hip is considered.

3. By eliminating other possibilities and demonstrating the similarity to the 2 previously recorded cases, a diagnosis is reached, namely, osteochondritis dissecans acetabuli.

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OSTEOGENIC SARCOMA

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A DIAGNOSIS of osteogenic sarcoma is difficult because of the variation in clinical and laboratory findings, and the greater percentage of cases reported in the literature have been verified at autopsy. This group includes chiefly those bony tumors called periosteal sarcoma. The term is eminently unsatisfactory, however, since most of these tumors do not arise in the periosteum, but as they progress involve all the structures of bone, i.e., periosteum, cortex and medulla. The registry has conveniently subdivided osteogenic sarcoma into four groups:

1. Medullary and Subperiosteal. In the majority of cases, a careful examination will show involvement of both periosteum and medulla.

2. Periosteal or those tumors which invade the periosteum and cortex without involving the medulla. These tumors are rare.

3. Sclerosing or those tumors in which a large amount of dense bone is formed. These are of slower growth and give a slightly better prognosis.

4. Telangiectatic or those bony tumors formed largely of vascular channels and blood spaces. According to Codman this type is very malignant and gives a poor prognosis.

ETIOLOGY

In reviewing the literature, the impression is gained that the theory of "the constitutional disposition of tumors" has been conceded very generally. Trauma seems to be associated frequently with the origin of the tumor, particularly the sarcomata group. Kolodny states, "The main specific condition required for the development of an osteogenic sarcoma is a stimulus to growth."

The growth ability of the tissue cells in adult organisms is not lost, but has changed from the actual kinetic to the potential stage. Trauma may lead to a temporary alteration of this potential growth ability, with complete elimination of growth restraint in the traumatized region. Sarcoma of bone, therefore, may be a loss of growth restraint, caused by injury to a previously healthy bone in which there is a constitutional predisposition to sarcoma.

In evaluating the causal relationship of trauma to sarcoma, a consideration of the time interval is important. In one-third of the cases of osteogenic sarcoma, about one month is the average time intervening between the trauma and the onset of tumor growth. It is very likely that the development of a bone tumor depends upon a number of factors acting together in such a manner as to produce a new growth. This would be especially true in individuals whose mesoblastic tissue elements have the inherent property of unrestricted growth when the proper stimulus is applied.

PATHOLOGY

The gross appearance of these tumors is produced, (1) by the aggressive action of the tumor cells, and (2) by a protective reaction of the involved bone. The steady growth of the tumor leads to bone destruction, while the defense reaction leads to new bone formation. The tumor usually spreads towards the cortex and along the medullary canal. The periosteum plays the chief role in the reaction of the involved bone and is most pronounced when the tumor is in its usual location, i.e. the metaphysis of long bones. The reaction consists of the formation of hyaline, osteoid and osseous tissue, arranged per-

pendicularly to the long axis of the bone-producing the typical "sun-ray" appear, ance on the *x*-ray film. At the terminal portion of the growth, where the tumor cells are less active, newly formed bone is deposited. This gives rise to the characteristic lipping which is an important diagnostic sign in osteogenic sarcoma.

Fig. 1.

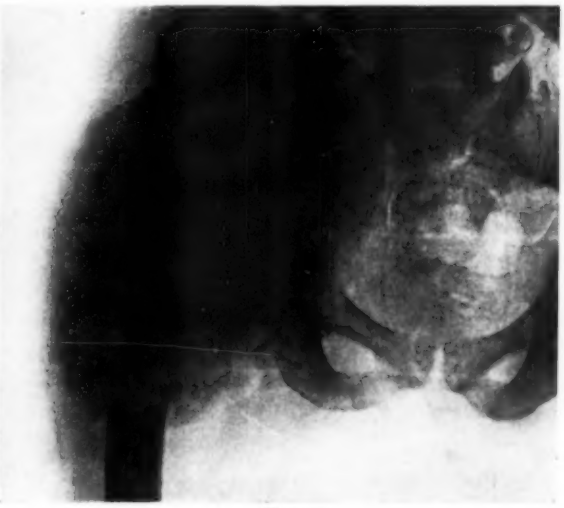

Fig. 2.

MICROSCOPIC EXAMINATION

Reveals all possible combinations of cells representing various stages of differentiation. The commonest type of cell is the small spindle cell with a chromatic nucleus. The giant and polyhedral cell also occurs. The important features of these malignant tumors are hyperchromatism and variation in size of the cells.

CLINICAL COURSE

Osteogenic sarcoma primarily affects younger individuals, although no period of life is free from the disease. It is encountered most frequently in the long bones, the metaphysis being the site of election. The lower extremity is more frequently involved than the upper.

SYMPTOMS

Pain is the first complaint, often dull and aching and may be intermittent but increases in severity as the tumor increases in size and is due to pressure on the sensitive periosteum. The interval of time elapsing between the appearance of pain and a palpable tumor, varies with the location. A fixed, immobile mass of firm consistency can usually be palpated, and generally enlarges very rapidly. "Pathologic fractures" are uncommon, but if one does occur, the callus when formed, is quickly destroyed by the tumor tissue.

Pain which is constantly present, is generally worse at night and causes a rapid depletion of the patient's condition. Profound anemia may occur in the late stages.

DIAGNOSIS

This is reached after a careful consideration of the history, age of the patient and location of the lesion. An initial onset of pain referred to the ends of one of the long bones, a palpable tumor and characteristic roentgenographic findings are significant.

To illustrate the difficulty of making an exact diagnosis in bone tumor, the following case is presented.

C. L. S., aged fifty-two years, male, was seen six months ago and gave the history of slipping and falling rather lightly on his right hip, followed immediately by mild pain in this region. He disregarded it and continued working. The pain, however, became progressively worse and the patient consulted several doctors including a chiropractor, all of whom treated

him on the supposition that he had arthritis. When he was eventually seen by us an *x*-ray picture revealed a fracture of the neck of the right femur.

A Whitman body spica was applied in the position of choice and removed at the end of six weeks. At the time the fracture was detected, no evidence of tumor growth was noted.

Following the removal of the cast, the patient was comfortable for about a week and then began to experience a recurrence of a constant severe pain, in the right hip joint, radiating to the right lower abdominal quadrant and lumbar spine. This discomfort was unrelieved by a change of posture and responded poorly to sedatives. Six months elapsed and during this time the patient pursued a progressively downward course, with a weight loss of approximately eighty pounds. A numbness of both legs was noted associated with an incontinence of urine, daily catheterization becoming necessary. Parasthesia of the lumbar region was also noted about this time. The urinalysis showed an albumimuria varying from 2 to 4+. A leucocytosis of 18,000 with 80 per cent polymorphonuclear leucocytes was present. Roentgenographs of the pelvis and lumbar region revealed a large tumor mass of the right ileum, which has apparently originated close to the acetabulum. The tumor is both productive and destructive. The new spicules of bone extend outward in a radial manner. The mass is fairly extensive being about the size of a grapefruit and in appearance is typical of osteogenic sarcoma. In addition, there is noted a rarefaction of the upper shaft and neck of the right femur and twelfth dorsal vertebra. An ununited fracture through the neck of the right femur is noted.

The differential diagnosis includes (a) Ewings Tumor. This tumor occurs in younger individuals and involves the shaft rather than the end of the bone. There is little tendency to new bone formation and the radiating spicules perpendicular to the long axis of the bone as seen in osteogenic sarcoma, are rare in Ewing's tumor. Metastatic growths generally occur in the skull and lungs.

(b) Syphilis of Bone. The clinical history is usually of a longer duration than in sarcoma. The Wassermann reaction is of great assistance. A fusiform enlargement of the shaft may be seen, but the involvement is more extensive than in sarcoma. The *x*-ray picture reveals dense, ivory-like new bone, which surrounds and involves the circumference of the shaft. In gumma, bone destruction is far in the ascendency over bone production.

(c) Giant Cell Tumor. These tumors start at the epiphysis and have a tendency to self-limitation and encapsulation. They appear to expand the bone and are surrounded by a thin, osseous shell. It is common for coarse trabecula to partition this type of tumor. The growth is much slower than sarcoma.

(d) Myeloma. This tumor selects the midportion of the shaft of the bones and is multiple. There is a circumscribed tumor growth with bone destruction. The condition frequently follows trauma but pain appears late. The rate of growth is slower than sarcoma and Bence-Jones protenuria may be present.

Other conditions to be considered are secondary malignant growths, benign osteogenic tumors, tuberculosis of the bone and osteitis fibrosa cystica.

This patient pursued a progressively downward course, lost weight, complained of increasing pain, in general lost ground steadily and expired from a terminal pneumonia.

Autopsy revealed a large encapsulated tumor mass extending 12 cm. medially from the crest of the right ileum and 15 cm. above the pubis, filling the entire illiac fossa and including the upper one-third of the right femur. The mass was covered with thinned out muscle tissue and periosteum.

Gross Pathology. The cut surface had an outer whitish layer corresponding to the periosteum. The tumor consisted of a whitish mass of fine spicules of bone embedded in a soft gelatinous material.

Microscopic examination showed homogeneous areas stained by hematoxylin without any cellular structure and round cells of the lymphoid type. Bone tissue was also present. Evidences of new growth were found in the lungs, liver, lymph glands, ribs and cervical vertebra. These findings pointed to a mixed chondroma such as myxochondrosarcoma.

[*Concluded on p.* 290.]

SACROCOCCYGEAL TERATOMA

REPORT OF CASE

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THE following unusual case of a sacrococcygeal teratoma containing a rudimentary intestine is reported because of the histogenesis involved and the excellent result following surgical removal.

CASE REPORT

A four year old girl, was admitted to St. Luke's Hospital, June 6th, 1935, for removal of a large tumor of the left buttock which had gradually increased in size since birth. The lower end had ruptured twice in the past year and watery fluid escaped. The skin was intact, it was not painful, and did not hinder walking but interfered with sitting.

The family and past history revealed nothing of importance and, with the exception of frequent colds, she was a healthy child.

She was well developed and well nourished. Examination of the different systems of the body showed nothing abnormal. A large round tumor was fluctuating in some places and solid in others, about the size of a grapefruit arose from the left gluteal region, (Fig. 1) and hung from the left buttock. Hard masses of the consistency of teeth or bone could be felt. At times there was visible peristalsis over an area about 3 inches in diameter in the upper part of the tumor, also noted when this area was pinched. For this reason it became necessary to rule out a hernia. A digital rectal examination showed no defect in the sacrum or any opening through which a hernia might protrude. *X*-ray study with barium enema and meal revealed no evidence of a hernia. *X*-ray pictures of the tumor, however, showed bone and teeth to be present.

Laboratory examinations consisting of Kahn blood test, complete blood count, urinalysis and examination of stool showed nothing abnormal. The Ascheim-Zondek test was not done, although it is of prognostic value in the treatment of teratoma testis.

On June 25, 1935, the tumor was excised under ether anesthesia. With the exception of considerable shock necessitating intravenous glucose, the operation was completed without difficulty but a large area of tissue was exposed because of the enormous size of the tumor. Any undue tugging would result in a marked increase in the pulse rate. Care in excising the tumor was necessary until the very end of the operation because the possibility of a hernia could not be eliminated until the last attachment to the sacrum was severed.

The following gross and microscopic description is taken from the pathological report of Dr. L. Y. Dyrenforth.

Gross. This specimen consists of a large mass, covered by skin removed from the buttock. Its attachment is broad, and the whole thing is as large as an ordinary sized grapefruit and weighs 350 grams. Beneath the skin there is evidence of a series of fluctuant sacs, separated by denser areas. These dividing walls are thick and contain isolated bone, some in the form of irregular, nondescript fragments tightly bound by the dense surrounding structure, and some in tooth like formations. The proximally situated cavities are several in number but only two are sizable. They are smooth walled and filled with a dark greenish-brown tenacious mucoid substance. Pressure on the other sacs shows the presence of small intercommunications. The most distal sac, however, is different, and is entirely a separate cavity. It is lined by a rugated mucous membrane like structure, comparatively thin walled, without microscopic evidence of a muscle layer and is filled by a thin mucoid, yellow-green substance.

Microscopic. Most of the supporting structure of the walls of the sac is indifferent, or ordinary loose to dense connective tissue, in which there are blood vessels, glands and smooth muscle fibers. Apart from the bone and cartilage noted grossly, the only other structure of interest is the lining membrane of the most proximal cavity. This is rudimentary intestine, consisting of a narrow band of mucous membrane, resting on a definite muscularis mucosa

and containing a well defined layer of smooth muscle. The mucous glands are short, but otherwise well formed. The stroma is pale.

A B

Fig. 1. Fig. 2.

Fig. 1A. Configuration of tumor.

Fig. 1B. Configuration of tumor. Peristalsis noted in upper part of tumor.

Fig. 2. Condition ten days after plastic repair and four months since first operation.

Diagnosis. Teratoma of the buttock region, containing rudimentary intestine, cartilage, bone and smooth muscle.

The child was readmitted to the hospital three months later, September 30th, 1935 for a plastic removal of redundant skin. The final result is shown in Fig. 2.

DISCUSSION

Teratomas have been variously defined as "parasitic foetus," "suppressed foetus" and "ill developed twin." Certainly they contain all three layers of germ plasm and any organ or structure in the body such as brain, eye, ear, trachea, intestine and solid abdominal viscera may be found in them. Bryans, of the Yencheng Sanitarium-Hospital, China, reported a large sacrococcygeal teratoma of the buttock containing rudimentary arm bones and a hand.

The important question of malignancy should be considered. Practically all recent reports support Ewing's concept that the more adult the type of tissue present, the less chance of the tumor being malignant. Hansmann and Berne reviewed 21 cases of sacrococcygeal teratomas from 1924 to 1930 and found that when muscle twitchings, peristalsis or bone could be demonstrated the tumor was always benign. Hence, the rapid rate of growth of the tumor which often parallels that of the infant should not be taken as evidence of malignancy.

Sacrococcygeal tumors have a rather constant retrorectal position just anterior to the sacrum. In the 21 cases reported by Hansmann and Berne all were located in this position. They conclude from this that the usual idea of histogenesis which holds that "the independent development of a blastomere during segmentation of the ovum or the development of a misplaced ovum," is erroneous and that the great majority of these tumors are remnants of the neurenteric canal. The embryological structures found in these tumors can be explained on this basis. Bone may be the result of "the normal biologic stimuli" to this region.

SUMMARY

The case here reported undoubtedly is of retrorectal origin and the structures found in this tumor may be accounted for on the basis of these observations.

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PROGRESSIVE POSTOPERATIVE GANGRENE OF SKIN*

REPORT OF CASE

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CASE REPORT

A WHITE male, aged forty-nine years, was admitted to a hospital on February 23, 1935, with diagnosis of an acute appendicitis and a history of three days illness. At operation an acute suppurative and gangrenous appendix with a localized mesenteric abscess and a slight amount of free peritoneal fluid were found. The wound was drained, removing it twelve days later and four days after this a purulent discharge was noted at the lower angle of the wound and a crateriform ulceration to the right of the wound. This was diagnosed as a local infection, and twenty-four days after admission, a note was made that a "carbuncle" was excised with the electrocautery. On the thirty-eighth day, excision of the necrosed areas was repeated. In the meantime, treatment with Dakin solution, staphylococcus jellies and silver nitrate solution was continued. On the seventy-ninth day he was discharged, apparently not healed. Two doses of roentgen therapy gave no marked improvement. The ulcerated zone was slowly increasing despite all treatment. On the eighty-fifth day of his illness he was admitted to the General Surgical Service of the Kings County Hospital showing a defect of the skin involving the whole right half of the abdomen, from the costal margin to the iliac crest, its base filled with bright and clean granulations. The wound edges were thickened, slightly elevated, serpiginous in outline and presented a necrotic appearance. About 10 cm. below and to the left of the umbilicus was a moderate sized area devoid of skin, also filled with clean granulations. The deep structures, muscles, etc., were not exposed. The site of the appendectomy incision was healed. Some small, non-tender lymph nodes were present in both inguinal regions, and a small, reducible right inguinal hernia. There were, also, numerous carious teeth. The patient's chief complaint was of severe abdominal pain in the ulcerated zone. On the ninetieth day, a dermatological consultation regarded this as being strictly a surgical condition. On the one hundred fifth and one hundred twenty-second days respectively an extensive debridement of the infected area was done with the electric knife without any improvement. The skin area involved was extending so that the present picture showed an almost complete involvement of the entire abdominal skin. On the one hundred thirty-third day he was transferred to the Division of Plastic and Reconstructive Surgery.

The necrosis continued to spread, with a characteristic raised, serpiginous border. On the one hundred seventieth day a new spreading zone started about the umbilicus. Treatment till now with cod-liver oil pastes, chlorinated lime, zinc peroxide, high vitamin diets, etc., were to no avail. On the two hundred and second and two hundred and twenty-sixth day respectively, excision of the ulcer at the periphery was done by means of the electric knife. The infection continued to spread; the pain was extreme. On the two hundred thirty-fifth day 1000 maggots were poured into the wound and held in place with a copper screen. In five days they were removed and for the first time the skin edge looked clean, except for a small area in the left lower quadrant of the abdomen. New maggots were applied for six days and were removed on the two hundred forty-eighth day of his illness. The wound looked cleaner than at any previous time except for the area in the left lower quadrant, and a small zone about the umbilicus. Three days after this the patient began to show signs of a rapid decline, becoming lethargic, stuporous and delirious, with nausea and vomiting. The blood pressure dropped. He presented a picture of exhaustion due to a long standing chronic infection. A transfusion of 200 c.c. of blood by the indirect method was given and repeated three days

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later. Inspection of the wound showed a remarkable improvement under the maggot therapy, extension had stopped, the edges had

Fig. 1. Abdomen before the skin graft.

flattened and were showing signs of epithelization, the necrotic zone was gone, but the patient became moribund and appeared to be doomed to exitus. A Levine tube was passed for the administration of medication and fluids. Intravenous glucose and insulin were given for nutrition; various stimulants were given parenterally; an extract of the adrenal gland (Swingle) and saline solution through the Levine tube was given to combat an adrenal insufficiency due to infection. In forty-eight hours he showed a definite improvement which continued until his discharge. On the two hundred fifty-ninth day he was given another transfusion of 150 c.c. by the indirect method. The wound looked even better than previously.

Shortly after, he complained of the return of pain in the abdominal area. On the two hundred sixty-ninth day, the right three-fourths of the ulcerated zone was covered with large conical shaped pinch grafts, held in place with paraffin mesh gauze and rubber sponges for pressure. One week later about 75 per cent of these grafts had taken. His subsequent course was satisfactory. His strength returned rapidly, he gained weight, etc.

On the two hundred eighty-eighth day, seventy-five pinch grafts of the large type were again placed on the abdomen and the wound dressed with the same gauze and sponges; about 90 per cent of these took by the end of one week. The patient was now up and about and was discharged from the Hospital on December 18, 1935, three hundred nine days from the onset of his illness. There were just a few small areas which had to granulate in for complete healing of the abdomen. In the last few weeks he received ultra-violet therapy, a definite aid in the healing of the wound. Numerous blood chemical analyses, urinalyses, Wassermann and blood cultures were done, but nothing abnormal was found. His red cell count varied from 3,600,000 to 4,000,000 with a hemoglobin of 70 per cent to 80 per cent. Cultures from the wound showed a profuse growth of a non-hemolytic streptococcus.

In 1924, Cullen[1] described a case of a "Progressively enlarging ulcer of the abdominal wall involving the skin and fat following drainage of an abdominal abscess apparently of appendiceal origin." After an extensive spread, the margins were cut with the cautery, the advance was stopped, the area pinch grafted and the lesion healed. That same year, Christopher[2] described a "Severe spreading carbuncular infection of the chest wall following rib resection under local anesthesia." He noted that the pain suffered was excruciating and the attendant emaciation of the patient was marked. This case responded eventually to the electric cautery. In 1935 Stewart-Wallace[3] collected 37 cases and showed that they could be grouped as a clinical entity under the title of "Progressive post-operative gangrene of skin." A history of a previous operative procedure, usually an appendectomy or for empyema, was obtained. The appearance of the lesion, the raised, swollen, thickened, slightly everted necrotic border, the serpiginous outline, the bright granulations, the exquisitely tender tissues, the progressive nature of the disease, all these are typical and constitute a definite entity. The failure of the lesion to respond to any method of therapy except the electocautery, although infrequent ones have responded to quartz light, 6 per cent sodium chloride and immunized blood transfusions[4,5,6] entitles this condition to be placed in a separate category.

Meleny[7,8] studied several cases bacteriologically. He isolated from such cases a Microaerophilic streptococcus and a Staphylococcus aureus. He demonstrated that the lesion was a product of bacterial synergism, and was able to reproduce the lesion in animals.

Fig. 2. The skin grafts which have taken are shown in situ.

Fig. 3. The abdomen healed.

The therapy of this condition has resolved into one important procedure. High vitamin diets, general nursing care, multiple blood transfusions, zinc peroxide, irradiated petroleum, cod liver oil pastes, quartz light, *x*-rays, local antiseptics of all types, etc., have been helpful but ineffective. Excision well beyond the border with the cautery has been the only effective means of controlling the spread of the lesion. However, in the last few years there has been an increasing literature on the use of maggots in various types of infections. They have been used successfully in carbuncles, sloughing leg ulcers, gangrene of the toes, etc., as well as originally in osteomyelitis. Ferguson and McLoughlin[9] used maggots in these conditions and also in one case of a hematoma and wound infection following repair of an incisional hernia, to remove the sloughing and necrotic tissues.

The use of maggots in cases of progressive postoperative gangrene of skin is not mentioned in the literature. In this case, despite multiple electrical resections of the tissues, the necrosis continued to advance. The change following the maggot therapy was so definite as to leave no question of its effectiveness. The suggestion is advanced that maggot therapy plus early resections of the involved tissues may be more effective than simple cautery therapy. The selective action of maggots for the necrotic and infected tissues would prevent needless wide resection of normal structures, our only means at present of controlling the progressive ulceration. Maggots are easily available and simple to apply.

The importance of early recognition of this condition of progressive postoperative gangrene of the skin must be emphasized. Too frequently it is only after weeks of spread and suffering that the true nature of the lesion is recognized. The condition is more prevalent than a search of the literature reveals. This particular case was originally diagnosed as a "boil," then a "carbuncle" and finally as an infection of the skin. It was only on the twenty-fourth and thirty-eighth postoperative days that cautery resection was instituted. Stewart-Wallace[3] mentions the following in the differential diagnosis of this condition:

1. Common wound infections.
2. Erysipelas.
3. Gas gangrene.
4. Hemolytic streptococcal gangrene of skin (Meleny).

5. Ecthyma gangrenosum.

6. Infections with specific organisms, such as diphtheria, tubercle bacillus, blastomycosis.

7. Amebiasis cutus.

8. Foul sloughing infections following human bites. The response of the ulcerated zone to this therapy is remarkable. The advance stops, the wound granulates and epithelial growth rapidly advances. Thiersch or pinch grafting shortens the convalescent period.

SUMMARY

1. A case of "progressive postoperative gangrene of the skin" is presented.

2. The condition must be diagnosed early. It is a clinical entity. Too often it has become an extensive lesion before its nature is recognized.

3. Maggot therapy is a useful aid in the treatment of this condition. Whether or not it alone is as effective or more so than the cautery, is problematical. In this case its use was undoubtedly effective.

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CONCLUSION OF ARTICLE OF DRS. ELMER AND BOYLAN*

CONCLUSION

1. The history of this case, discounting the age element was strongly suggestive of Ewing's Tumor, but, the clinical course and roentgenographic evidence pointed quite definitely to osteogenic sarcoma.

2. It is a matter of conjecture just what casual influence, if any, this man's previous fracture played in the production of the tumor. Did it, as Kolodny states, produce a stimulus to growth and lead to an elimination of growth restraint in the traumatized region? Certainly it is known that a tumor was not present before the fracture occurred, at least, it could not be detected by *x*-ray examination. Furthermore, the tumor mass seems to have taken origin in the vicinity of the traumatized area.

3. The clinical course of this case was followed carefully. Frequent *x*-ray pictures were taken but a final diagnosis was not made definitely until autopsy.

4. One should bear in mind the possibility of a bone malignancy occurring in the course of an apparently innocent fracture if the proper constitutional predisposition is present.

* *Continued from p. 284.*

HYDRONEPHROSIS DUE TO BALL-VALVE OBSTRUCTION BY PAPILLOMA AT URETEROPELVIC JUNCTION*

MEREDITH F. CAMPBELL, M.D., F.A.C.S.

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HYDRONEPHROSIS caused by an irregularly growing neoplasm of the kidney or renal pelvis and blocking the pelvic outlet is a relatively common urologic observation. Recently, however, an infected hydronephrotic kidney was removed from a man of twenty-four years of age in whom the obstruction was a papilloma which functioned as a ball-valve at the ureteropelvic junction. Diligent search of the literature has failed to reveal a similar instance but I cannot believe that the condition is as unusual as this failure implies. Yet the case is reported not because of its rarity but for its surgicopathological interest and the peculiar problem in urographic diagnosis presented. Inasmuch as the man had been treated for "chronic pyelitis" for many years and had twelve stones removed from the kidney only seven months prior to the discovery of his renal growth, it was thought the present obstruction was due to a non-radiopaque stone at the pelvic outlet which caused a negative or filling defect shadow. Operation proved the "stone" to be a papilloma which produced ball-valve obstruction (Figs. 1 and 2).

CASE REPORT

N. F., Italian, painter, aged twenty-three years, was admitted to the Urological Department of Mountainside Hospital, January 15, 1935 complaining of attacks of right abdominal pain of fourteen years duration, which began at the age of nine years, in the region of McBurney's point. There was intermittent hematuria and burning on urination. During one of the sharper attacks of pain at sixteen years of age the appendix was removed. The right sided pain persisted, typical attacks of renal colic appeared and an *x*-ray film showed a moderate size stone localized to the right renal pelvis. Shortly after the appendectomy a cystoscopic examination yielded no additional information but for some inexplicable reason pyelography was not performed.

When the writer first saw the boy on January 30, 1935, he made a note "the long history, since nine years of age, suggests congenital ureteropelvic obstruction, probably an aberrant vessel. Believe the calculi are secondary." Urologic investigation by excretory urography, cystoscopy, ureteral catheterization and bilateral retrograde pyelography revealed a normal left upper urinary tract. On the right there were infected (staphylococcus) hydronephrosis with advanced renal destruction, multiple calculi in the pelvis, thought previously to be gallstones, an ill defined urographic outlining of the pelvic outlet, calcified lymph glands over the sacrum and fifth lumbar vertebra in the midline and over the left transverse process of the fifth lumbar vertebra. The blood non-protein-nitrogen estimation showed 30 mgm. per 100 c.c. The phenolsulphonphthalein excretion was 68 per cent in two hours; the Wassermann was negative and the blood count disclosed a slight leucocytosis.

February 11, 1935, a right pyelotomy was done. Through a curved incision the kidney was mobilized. The peritoneum was opened to permit palpation of the gall bladder which was found normal. Following the closure of the peritoneum, 1 large 2 cm. and 11 small phosphouratic stones varying from 0.5 to 1 cm. in diameter were removed from the kidney by posterior pyelotomy. There was moderate sclerotic peripyelitis with rather marked scarring at the ureteropelvic junction which was liberated to a degree which seemed to assure free pelvic drainage. The wound was closed with cigarette drainage in the usual manner, one drain being left down to the unsutured pyelotomy incision. The patient left the hospital in three weeks.

During the following seven months albuminuria, moderate pyuria and a mild pain in the right renal region persisted. The patient failed

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to gain strength and weight. He was advised to reenter the hospital. Right retrograde pyelography showed a filling defect or negative shadow (Fig. 1) in the ureteropelvic area and caused the writer to make the erroneous diagnosis of calculus, probably uric acid, obstruction at the pelvic outlet.

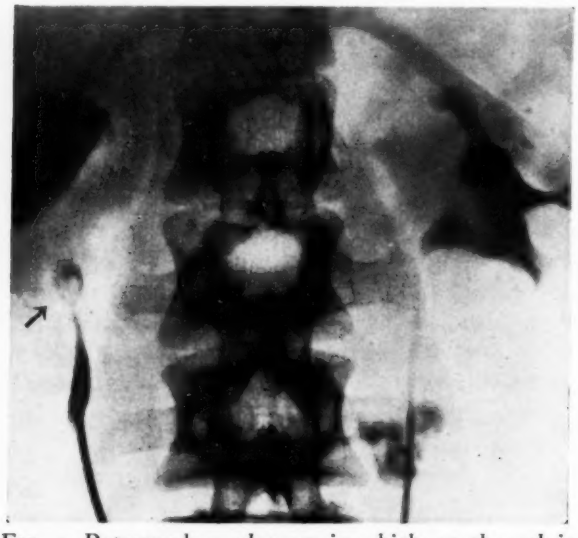

FIG. 1. Retrograde pyelogram in which, at the pelvic outlet, is seen the filling defect or negative shadow produced by the papilloma. The pelvis is hydronephrotic.

On renal exploration on September 25, 1935, the kidney was found densely embedded in a postoperative scar and removed because of advanced damage by hydronephrosis and infection. The ureter was found kinked over the lower pole of the kidney; doubtless this was a sequel of the previous operation. The operative wound was closed in the usual manner and with cigarette drainage for 48 hours. The patient was discharged fourteen days postoperatively.

Pathological Report (Dr. M. J. Fein). Macroscopically the kidney measures 10 × 5 × 2 cm. The capsule strips with ease and the surface is smooth. On cut section, the pelvis and calyces are found to be considerably dilated (Fig. 2). The pyramids are destroyed and the cortex is thinned and uneven. The striations are indistinct.

In the pelvic ureteral orifice there is a round reddish-brown tumor which measures 6 mm. in each diameter. It is attached by the narrow pedicle to the mesial wall of the orifice and causes a ball-valve obstruction.

Microscopically the remaining kidney structure shows atrophy of the tubules; the glomeruli vary from normal to those that are atrophied and fibrosed.

The neoplasm in the ureteral orifice is covered by a layer of stratified epithelium arranged about a connective tissue core in which the blood vessels are contained.

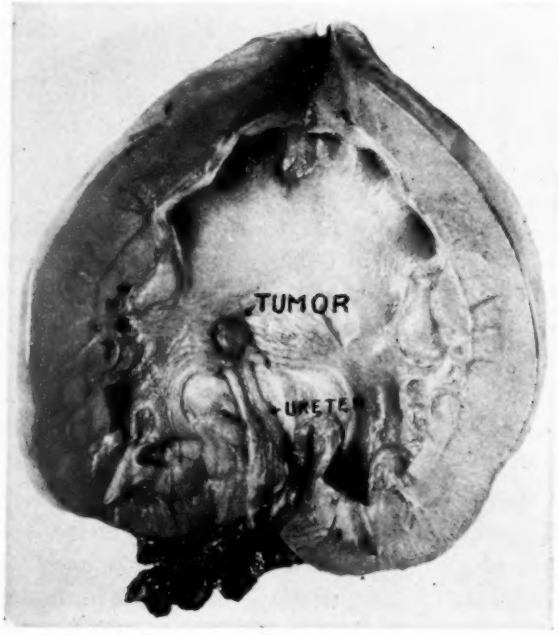

FIG. 2. Surgical specimen. The position of the papilloma at the pelvic outlet is well shown.

Diagnosis. Papilloma of the ureteral orifice; infected hydronephrosis.

COMMENT

Judging by the slow evolution of a growth such as was found at the pelvic outlet, the lesion may have been present for several years and have been the principal accessory etiologic factor not only in the perpetuation of the renal infection but also in the formation of the stones removed seven months prior to nephrectomy. The rarity of cases in which pelvic irritation by stones might be considered to be an etiologic factor in tumor formation would suggest that here, too, no such relationship existed. Yet in this present case a pelvic stone was known to exist for twelve years with a clinical history of fourteen years and during a period of comparatively rapid body growth and tissue changes during adolesence. It is, therefore, conceivable

that chronic irritation produced by stone and infection may have been a predisposing factor, at least, in the development of the papilloma.

Urographically the filling defect caused by the tumor at the ureteropelvic junction so closely simulated the negative shadow of a non-radiopaque calculus that the combination of the urographic observation and the previous pyelotomy for stone led to the erroneous diagnosis of calculus obstruction. Pure uric acid stones cast no roentgenographic shadow and in a pyelogram are often outlined as vacuoles or filling defects.

Theoretically, should the diagnosis be correctly made in a case such as is reported here, the conservative surgical treatment is resection of the tumor-bearing ureteropelvic junction followed by ureteroneopyelostomy. Yet the degree of malignancy of the tumor can scarcely be known and conditions favorable to the performance of such an operation are most unlikely to exist. Moreover, the anastomosis of a normal ureter to the lower renal pelvis is almost certain to be followed by dense stricture at the site of union. These considerations and, more particularly, advanced hydronephrotic renal injury, call for nephrectomy, as in my case.

SUMMARY

A case of hydronephrotic renal destruction secondary to a ball-valve papilloma at the pelvic outlet is reported. Chief interest focuses upon the diagnosis; attention has been directed to the urographic filling defect caused by the growth but which might justifiably be thought to be produced by a non-radiopaque calculus. Nephrectomy is the usual treatment.

POSTOPERATIVE CASE OF LATE AND DISABLING ULNAR NERVE PALSY

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J. H. M., white, male, married, aged forty-six years, occupation fireman and driver for a fire company, was admitted to St. Joseph's Hospital, November 20, 1934.

Symptoms. He complained of weakness and loss of sense of touch, numbness and tingling in the little finger, the outer half of the ring finger of the right hand, and the ulnar side of the right forearm. These symptoms became pronounced in June, 1934 and were disabling a little later so that he was unable to continue driving the fire apparatus or play his accordion.

History. He fractured his right elbow when he was one year old. Details of the treatment of this fracture can not be obtained except that there was nothing unusual about the treatment and the end result and function obtained were satisfactory.

Family history, habits, past health, physical examination and laboratory studies were either negative or have no bearing on the condition.

Examination of Right Upper Extremity. The right elbow appears enlarged on the inner side with an increased carrying angle, or decubitus valgus deformity, measuring 40°, which is approximately 30° more than normal. There was definite weakness and limited function of the hand and forearm with some atrophy of the hypothenar eminence and the intrinsic muscles of the hand.

X-ray examination reads as follows: "There is a suggestion of an old fracture or bone injury to the right olecranon at the elbow joint. This has resulted in some angulation at the elbow. Diagnosis: Old fracture of elbow joint."

Preoperative Neurological Examination. A marked hypalgesia approaching anesthesia was present in the little finger, ulnar half of the ring finger, and inner side of the dorsum of the hand and of the right forearm with atrophy of the intrinsic muscles of the hand. There was numbness and clumsiness in the movements of the hand and weakness of flexion n the little finger, the terminal phalanges and in adduction and abduction of the fingers and in adduction of the thumb.

Operation, November 20, 1934. An incision was made over the right elbow. The ulnar nerve was exposed and dissected out, being lifted from the groove with comparative ease. There was a fusiform swelling of the nerve for 1 to 1½ inches. The nerve was placed in front of the internal condyle under a flap of muscle and muscle sheath, using catgut to suture the fascia and muscle sheath. Dermal sutures were used for the skin.

Postoperative Neurological Examinations. Dec. 1, 1934. "Patient shows almost complete return of function in the right ulnar nerve. I can detect no disturbance in sensation and no motor weakness in the 4th and 5th fingers. Some atrophy exists but this will probably clear up in a short time. I believe the patient will make a complete recovery."

February 10, 1935. The numbness of forth and fifth fingers has cleared partially. He is now able to fulfill his duties as a fireman to a much greater extent than formerly. There is still weakness of the little finger. Flexion of the ring finger is intact. There is slight weakness in flexion of the terminal phalanges as well as in adduction and abduction of the fingers and in adduction of the thumb. There is diminution of pain sensation along the ulnar nerve distribution which is associated with hypersensitivity, a pin felt dull but produced a very unpleasant sensation. Some atrophy of intrinsic muscles of the hand still persists. Vibratory and joint position sensation in the small finger was normal.

Opinion. "Definite improvement in motor power and sensation. Hypersensitivity of the skin is indicative of returning function in the ulnar nerve."

Final Result. There has been gradual motor and sensory improvement. By November 1, 1935, he claims to have completely recovered his full strength and motor power and entirely lost all abnormal sensations of the affected part. He is able to drive his fire truck and play

his accordion as well as previously. In addition he has a larger range of motion at the elbow in flexion and extension of his forearm. He also has increased function, for example, he is now able to comb the hair on the back of his head and button his collar button on the back of the neck with his right arm which he was unable to do formerly.

COMMENT

There are over 100 cases of late and disabling ulnar nerve palsy reported following injury of the external condyle but in searching through the literature I was unable to find one with as long a symptom free period. He fractured his elbow at the age of one year and had no trouble until the age of forty-six years, approximately forty-five years after the original injury, a symptom free period of forty-five years.

SUMMARY

The history of a fractured elbow at the age of one year followed by a disabling ulner nerve palsy at the age of forty-six years presents an unusually long symptom free period. The symptoms began with disturbed sensation, weakness, and finally atrophy, increasing in severity until they became disabling. The operation provided a new route for the ulnar nerve in front of the internal condyle. The improvement after operation was immediate and marked, so that eleven days after operation a neurological examination showed almost complete return of function in the right ulnar nerve. The end result was very satisfactory with freedom from all symptoms and recovery of his full strength and motor power. He is enjoying increased function and a larger range of motion at the elbow than at any other time during his life.

RUPTURED TUBAL PREGNANCY WITH MASSIVE RETROPERITONEAL HEMORRHAGE*

CASE REPORT

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NEW YORK

WHEN there is interference with the passage of a fertilized ovum through the oviduct a tubal pregnancy results, the most frequent cause being chronic follicular salpingitis with its resultant altered tubal mucosa in the form of adhesions between the folds and false diverticula (Williams,[1] Opitz,[2] Falk[3]). As the progress of the ovum is hindered, imbedding takes place at the point of arrest and varies with the site in the tube at which the ovum is stopped. Near the fimbriated extremity luminal imbedding occurs, whereas towards the cornua of the uterus the mural type is more frequent (Falk[4]).

The clinical course of the disease bears a direct relationship to the type of imbedding and its location in the tube. In the luminal type near the fimbria the clinical symptoms are usually milder and result in more frequent tubal abortions with hematocele formation. On the other hand, with the mural type near the uterine end there is tubal rupture with its associated acute and grave symptomatology.

Tubal rupture is either intra- or extraperitoneal, that is, between the layers of the broad ligament when it is called intraligamentary. Intratubal abortion with rupture into the peritoneal cavity is by far the most frequent termination of tubal pregnancy. Intraligamentary, however, is very uncommon and occurs about once in 75 cases. Williams[5] quoting statistics of Mandl and Schmidt, Kustner and Fehling finds it noted 4 times in 276 cases and in 50 specimens personally examined found it but once.

Frank[6] found only one instance in a study of 80 cases.

Urdan[7] in a clinical study of 474 cases mentions intraligamentary ruptures in 7 patients. From these figures we find the average incidence of intraligamentary in tubal pregnancy is 1.4 per cent.

Following intraligamentary rupture the pregnancy may pursue one of several courses:

1. It may continue unrecognized to term, when by operation a living child is extracted (Tissier and Wiart[8]); or the pregnancy may continue from the time of rupture for several months and a viable or non-viable fetus delivered by operation (Tallaferro[9]).

2. The pregnancy may continue for a time followed by the death of the fetus and retention of the uninfected gestation sac for varying lengths of time (Merial,[10] Lemercier,[11] Gilles and Pont,[12] Flatan[13]).

3. With rupture between the folds of the broad ligament and immediate death of the fetus, a hematoma forms which may or may not rupture secondarily into the peritoneal cavity. If secondary intraperitoneal rupture does not take place and if the bleeding continues, a huge retroperitoneal hematoma forms lifting forward the colon, peritoneum, etc., as the blood dissects its way upward. That this is unusual is evidenced by the finding of only one such case report, that of Pancot[14] who described it in 1924.

Following is the report of a similar case.

B. S. Gravida 3, Para 2, colored, twenty-eight years of age was admitted to Harlem Hospital, April 14, 1932, complaining of severe abdominal pain of two days duration. Her menstrual history was normal; no dysmenorhea; last period being in January, 1932. Early

* From the Service of Dr. H. C. Falk of Harlem Hospital.

in February the patient began to "spot" which continued for six weeks but no free bleeding at any time. On March 5, she experienced a sudden, severe, shooting pain in the lower abdomen and which continued intermittently throughout the day. The next twenty-four hours she felt very well. On the third day the pain recurred but more severe than at onset and the patient entered hospital feeling very weak and in acute pain.

On admission there was marked pallor of mucous membranes, restlessness, and slight air-hunger, B.P. 122/66. The heart and lungs were normal. The abdomen was somewhat distended and more prominent on the left. The right side was soft, the left distinctly rigid, with an indefinite, soft mass; no shifting dulness though the left flank was dull. The perineum was firm and the vagina roomy; the cervix was closed, firm, directed toward the hollow of sacrum; no bleeding was present. The uterus was anteflexed, slightly enlarged, firm and pushed to the right. The fornices were clear.

Red blood count showed 2,980,000 cells hemoglobin and 60 per cent; white blood cells 22,300 with a differential count of polymorphonuclear cells 77 per cent, lymphocytes 16 per cent, band forms 7 per cent. Sedimentation time was settling of 13 mm. in one hour.

Notwithstanding that the history and some of the findings upon examination pointed to a diagnosis of ruptured ectopic pregnancy, owing to the absence of physical signs of free fluid and with the lateral displacement of the uterus by a mass lying out of the pelvis, a preoperative diagnosis of a left ovarian cyst with a twisted pedicle was made.

Operation. Through a left subumbilical incision the peritoneal cavity was opened. No free fluid was found. The peritoneum of the left iliac fossa, the left lumbar gutter and the superimposed descending colon appeared elevated and deep purple in color. The normal sized uterus was lying in the hollow of the sacrum pushed over to the right by a hemorrhagic left tube, 4 × 5 × 6 cm., bound down in the cul-de-sac. A retroperitoneal collection of blood was evident. An incision 2 cm. long was made over the inner third of the left tube and the fetal sac with a 1.5 cm. fetus delivered. Clamps were placed on the infundibulopelvic ligament and the mesosalpinx and cut. The layers of the mesosalpinx were widely separated by the accumulated blood underneath it. The tube was removed, including excision of the uterine cornua. Figure-of-eight suture at the cornua and transfixion sutures along the mesosalpinx were placed for hemostasis. The left ovary appeared normal and was not removed. Another incision 5 cm. long was made through the peritoneum of the left iliac fossa and about 750 c.c. of clotted blood was evacuated from the retroperitoneal space. This incision was closed with plain catgut. The abdomen was closed without drainage.

Convalescence entirely uneventful, the wound healed by primary union and the patient left hospital on the fourteenth postoperative day.

Pathological Report. Specimen consists of a Fallopian tube 6 cm. long, the fimbriated extremity is agglutinated and the proximal end dilated to the size of a large walnut with a rupture 1 cm. in diameter. The dilated portion is filled with clotted blood and lined by a shaggy membrane.

Microscopic Examination. Section of the tube shows numerous thickened villi projecting into the lumen. Adjacent villi have fused to form pseudoglandular spaces. The stroma consists of large polygonal connective tissue cells. There is moderate round cell infiltration. Imbedded in the outer portion of the muscular wall is a mass consisting of clotted blood, degenerating chorionic villi and large connective tissue cells with abundant cytoplasm and pale nuclei.

Diagnosis. Chronic salpingitis; tubal pregnancy.

SUMMARY

A case of ruptured tubal pregnancy is described. There was no free blood in the peritoneal cavity, the gravid tube having ruptured between the folds of the broad ligament forming a massive retroperitoneal hematoma with a mural type of imbedding of the ovum in the inner third of the tube.

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PERIRECTOSIGMOID ENDOMETRIOSIS SIMULATING CARCINOMA

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ENDOMETRIOSIS is one of the most interesting and bizarre diseases of embryonic origin encountered in the female. This pathological phenomena is characterized by proliferating endometrial deposits in various organs and tissues, which must have been distributed diversely in these unexpected localities since the beginning of ovarian function, remaining quiescent and without symptoms; then, without apparent premonitary cause, activation starts the sequence of symptoms, depending upon the location of these ectopic endometrial deposits. Symptoms may be single or multiple; their severity depending upon the site and their effect upon the surrounding structures.

It is essential that the gross appearance and symptomatology of this pathological curiosity should be familiar to both gynecologist and surgeon. The differential diagnosis between pelvic endometriosis and chronic inflammation of the broad ligaments and tubes, particularly the "baked in" or "frozen type," is clinically not easy.

In the pelvis the most important characteristic of endometriosis is the tendency to form exceedingly firm, almost gritty fibrotic exudate and very hard, unyielding pelvic adhesions.

The composite clinical picture should be carefully interpreted in order to make the proper diagnosis, if possible. In many instances, it can only be made at operation, by visual evidence of the presence of endometrial transplants scattered upon the uterus, tubes or ovaries, and the exceedingly dense and unyielding character of the base of the broad ligaments. Some cases though clinically endometriosis, may not be proved to be so if the pathological findings show no endometrial transplants. In the case here reported it was the interesting history and the clinical picture with the findings at operation which determined the diagnosis, but not before operation. The endometriosis caused an unusually hard, gritty exudate in each broad ligament at its base, making it most difficult to mobilize the uterus even after the broad ligaments were severed. The feel to the finger and to the touch is quite different from that of chronic pelvic inflammation or chronic exudate in the broad ligament. While small individual endometrial deposits could not be demonstrated anywhere, the resulting pathological changes and exudate from proliferations were of sufficient density to cause perirectosigmoid fibrosis and at each menstrual period cause a definite narrowing of the lumen of the bowel at the rectosigmoid junction followed by partial intestinal obstruction. A left inguinal mass at the external ring was an endometrial deposit causing periodic cyclic premenstrual and menstrual symptoms. A few days prior to menstruation, this mass would become enlarged, attain a certain size, then decrease and remain small after menstruation.

Depending upon the location of the endometrial deposits, the cyclic character of the symptoms, therefore, is of important clinical significance and should be so evaluated. The symptoms whatever they may be, gradually set in a few days before menstruation, attain their height during menstruation and decrease after menstruation.

The patient in this case was comparatively comfortable between menstrual periods a few days prior to and during menstruation she had all the symptoms of partial intestinal obstruction with disten-

sion due to mechanical ileus, nausea and vomiting, with a moderately painful enlargement of the mass in the left inguinal region, these symptoms reaching the apex during menstruation and gradually subsiding as the periods were ended. After menstruation the bowel function became normal. Proctoscopic examination showed a rigid obstruction at the rectosigmoid junction with marked narrowing of the lumen of the bowel. The mucosa was puckered into folds, red and congested but was otherwise normal in character. It did not have the appearance of carcinoma. On the presumption that this patient was suffering from a rectosigmoid carcinoma a colostomy was to have been performed by another surgeon, during one of the periodic attacks of ileus. There was also present a small endometrial deposit posterior to the cervix in the rectovaginal septum.

The etiology and pathogenesis of this interesting disease is well described in monographs by Sampson, Cullen, Novak, and others, while the resume by Hosoi is found in the International Surgical Digest, Vol. 13, June 1932, No. 6, W. F. Prior and Company.

According to Sampson, pelvic endometriosis occurs in 10 to 20 per cent of women between the age of thirty years and the menopause. Sterilization by *x*-ray therapy or a bilateral oophorectomy usually cures the symptoms resulting from the endometrial deposits in structures other than the pelvic organs.

CASE REPORT

J. A., aged forty years, married, was admitted August 1, 1932 for partial intestinal obstruction and a fibroid uterus. She complained of pressure over rectum during menses, occasional menorrhagia and loss of 35 pounds during the past year and difficult bowel movement. Her menstrual history was normal. She was never gravid. There was inability to have normal bowel movements for ten days premenstrually, comenstrually and for one week following menstruation. Between menstrual periods, the bowels were normal, the pressure in the rectum, the bearing down sensations, the enlargement of the "gland" in the left groin, the symptoms present prior

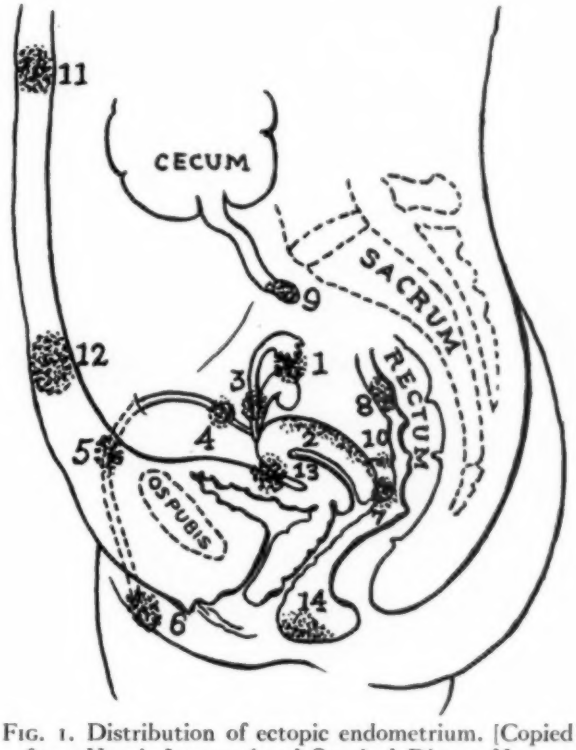

Fig. 1. Distribution of ectopic endometrium. [Copied from Hosoi, International Surgical Digest, Hagerstown, W. F. Prior & Co., 13: 6, 1932.] (1) Ovary. (2) Uterine wall. (3) Fallopian tube. (4) Intraperitoneal portion of round ligament. (5) Groin-intracanalicular and extra peritoneal portion of round ligament. (6) Labium majus-extra peritoneal portion of round ligament. (7) Rectovaginal septum. (8) Rectosigmoid. (9) Appendix. (10) Uterosacral ligaments. (11) Umbilicus. (12) Laparotomy scar. (13) Urinary bladder. (14) Perineum.

to and during the menstrual period, would subside and become normal between periods. There was never any blood or mucous in the stools. The onset of her symptoms started about one and one-half years ago when the patient had menorrhagia twice followed by the pressure and bearing-down sensation during the menstrual period. Since then, each month at the time of the menstrual period the bowels would not move, there was an associated loss of appetite and she would vomit if she ate. There has also been a coincidental loss of weight.

Summary. Ill one and one-half years with menorrhagia, recurrent constipation, bearing down sensation and pressure in rectum ten days prior to and during menstruation, nausea

and vomiting, enlargement of "gland" in left inguinal region during menstruation; loss of weight and abdominal distention.

Physical Examination. The patient was spare and somewhat emaciated. The lungs, heart and pulse were normal. The blood pressure was 146/100. The temperature was normal. The abdomen was somewhat distended, showing loops of distended small bowel, a palpable non-tender mass in the suprapubic region and a hard, elongated nodule in the left inguinal region.

Vaginal Examination. Fairly large retroverted fibroid uterus, fixed between normal adnexa. There was considerable hard, somewhat painful, rigid infiltration in the fornix and to both sides laterally from the cervix.

Rectal Examination. A hard non-yielding, ring-like infiltration about the rectosigmoid junction, extends around the entire circumference of the rectum and forms a definite stricture through which even a lead pencil would not pass.

Prostoscopy. The prostoscope can be introduced only at an extreme pelvic angle and then meets a firm resistance above and beyond the first valve. Prostoscopy shows infiltration and edema of the rectal mucosa, not characteristic of carcinoma and does not bleed. No mucous was seen.

Operation. August 5, 1932. Under spinal anesthesia, a supravaginal hysterectomy and bilateral salpingo-oophorectomy was done. There was a general gritty infiltration of the base of the broad ligaments but no evidence of endometrial deposits anywhere.

Preoperative Diagnosis. Fibroid uterus, retroverted 3°, impacted and endometritis.

Through a low median incision the uterus and pelvic organs were found to be firmly bound by thick adhesions to the pelvic colon and rectum. On the right side a pedunculated fibroid was densely adherent to the right pelvic wall and rectum. The uterus was bound down anteriorly to the bladder and posteriorly to the rectum and was delivered with great difficulty. A supravaginal hysterectomy was performed for multiple fibroids with considerable difficulty because of the dense adhesions binding the uterus to the bladder and rectum, suggesting the possibility of a carcinoma of the base of the broad ligament. Because of continuous oozing from the separation of the adhesions, two cigarette drains were introduced and the abdomen closed in layers.

Five days postoperatively, rectal examination showed much more narrowing of the bowel lumen which did not admit the finger into this densely hard contraction. There was a great deal of perirectal hard infiltration which felt like an infiltrated peri-rectal exudate causing the stricture of rectum. A colostomy for relief was considered.

Revision of History. With the rectal and vaginal findings of the hard, painful, cul-de-sac, the narrowing of the rectum at the rectosigmoid junction, the mucous membrane of the rectum being normal with the pathological findings at operation, the diagnosis of a severe degree of endometriosis of the pelvic floor with contraction involving the perirectal tissue could be made.

She was discharged the eighteenth postoperative day after a stormy convalescence attributed to intestinal distention due to the mechanical narrowing at the rectosigmoid junction which caused a paralytic ileus during the end of the second week, but improved without surgical intervention.

Pathological Report. The gross specimen consists of a uterus, a large fibroid nodule and tubes and ovaries. The uterus has several small fibroid nodules protruding from the side mass and measures 5.5 × 4 × 2.5 cm. There are several polypoid structures in the endometrium. The tube serosa is congested and measures 4 × 1 cm. On section the mucosa is hyperplastic. The ovary measures 3.5 × 2.5 cm. and feels cystic. There is a small follicular cyst at the lower pole, otherwise it is negative. The other ovary hard and fibrous.

Histological. Sections of uterus show hypertrophy and edema of the endometrium of the premenstrual type. The fibroid shows typical histology. Sections of tube show congestion of the wall and the mucosa. There are many plasma cells in the submucosa. Sections of the ovary show a small retention cyst and a degenerating corpus luteum. Serial sections of the uterus, ovaries and round ligaments reveal no evidence of endometriosis.

Pathological Diagnosis. Fibroid uterus; chronic salpingitis and cystic ovary.

Later Observation. When last seen, four months after operation she feels entirely well, has gained 20 pounds in weight, the swelling on the left side has disappeared entirely, the bowel movements are normal and there has been no further nausea or vomiting.

Rectal Examination. A normal sized proctoscope was easily passed through the former pencil sized narrowing; the mucosa appeared normal.

Vaginal Examination. The endometrial deposits at the cervix and fornix have disappeared. No mass is palpable in the left inguinal region.

SUMMARY

1. Endometriosis is not uncommon.

2. Symptoms depend upon the location of the endometrial deposits.

3. History eliciting periodic symptomatology is of great importance in diagnosis.

4. Lack of visual implants at the time of operation does not mean that endometriosis is not responsible for symptoms or pathology found.

5. The general surgeon should be familiar with the diverse characteristics of endometriosis.

6. A case is presented of perirectosigmoid endometriosis simulating carcinoma causing a rectal stricture, with endometrial deposit in the extra-peritoneal portion of the round ligament and an impacted fibroid uterus.

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* *Continued from p. 297.*

EXTRA-ABDOMINAL TUMOR OF ROUND LIGAMENT FOLLOWING UTERINE SUSPENSION*

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TUMORS of the round ligament, either intra- or extra-abdominally, have been reported in the literature from time to time since Sanger's original record of a case of fibrosarcoma of the round ligament which he reported in 1883. However the development of such growths extra-abdominally in previously suspended uteri, with implantation of the round ligaments into the layers of the abdominal wall, fails to be mentioned in an extensive review of the literature dating back towards the end of the last century. In the chapter discussing the remote results of operations for suspension of the uterus in Berkeley and Bonney's latest "Textbook of Gynecological Surgery," they fail to record the occurrence of such growths. It is because of the extreme rarity of its occurrence and since this tumor was so diagnosed preoperatively, that this case is being published.

CASE HISTORY

S. D., aged thirty-three years, white, housewife, gravida iii, was admitted complaining of an increasing lump in the right lower quadrant of the abdomen.

Past Surgical History. Operated in St. Elizabeth's Hospital, January, 1933 at which time an electrocauterization of the cervix, appendectomy and Crossen-Gilliam suspension of the uterus were performed.

The past medical and her family history are negative.

Menstrual History. $13 \times 5 \times 30$, always regular, no dysmenorrhea.

Marital History. Married eight years, gave birth to three children, the last, eighteen months after her operation, having been delivered spontaneously in September, 1934.

Present History. Six months prior to admission to the hospital the patient noticed the appearance of a painless lump in the right lower quadrant of the abdomen near the anterior superior spine of the ilium, gradually increasing in size and causing no pain. It was only slightly tender to touch. There were no accompanying symptoms. The patient had gained weight constantly but complained of marked fatigueability. Her bowels moved regularly without the aid of laxatives or cathartics.

Physical Examination. The head and chest were normal. On inspection of the abdomen, there was an ovoid mass about the size of a clenched fist in the right lower quadrant lying obliquely and just mesially to the anterior superior spine of the ilium. This mass was apparently firm, not freely movable, seemingly fixed on its undersurface and apparently attached to the anterior superior spine and seemed to lie below the aponeurosis. It was not very tender to touch. On vaginal examination, the introitus admitted two fingers with ease; the cervix was small, smooth and firm, non-eroded and non-lacerated; the uterus was of normal size and consistency and lay in its normal anteverted suspended position; the adnexa were normal. A combined abdomino-vaginal palpation of the tumor revealed that it did not encroach upon the pelvic viscera and that it was apparently lying in the anterior abdominal wall.

Preoperative Diagnosis. Fibromyoma of the round ligament in the anterior abdominal wall; the possibility of a ptosed right kidney or retroperitoneal tumor are to be ruled out by *x*-ray examination.

Cystoscopic X-ray Examination. A No. 21 F. Buerger cystoscope was inserted into the bladder. The bladder mucosa was normal in appearance. The left ureteral orifice was easily catheterized. The right ureteral orifice was entered into with great difficulty because of distortion by the extrinsic pressure of a mass. The urine obtained from each kidney was normal. The phenolsulphonapthalein test was normal. The right ureter was injected with 8 c.c. of 12 per cent sodium iodide solution.

* Presented before the Clinical Society of Sydenham Hospital March 9, 1936.

X-ray Examination of Genito-urinary Tract. A routine view of the abdomen and pelvis shows the kidneys normal in size, position and contour. Irregular calcific deposits are present at the right side of the level of the fourth and fifth lumbar vertebra in the region of the psoas muscle. Pyelography of the right kidney shows slightly distended pelvis and calyces but no pathologic changes. The right ureter is deviated medially at the fourth and fifth lumbar levels presumably by a mass extrinsic to the urinary tract. The calcified deposits noted are apparently within this mass.

X-ray Examination of Colon. The examination of the colon by a bariumized enema shows no evidence of an obstruction or intrinsic lesion. In the partly filled state there is irregularity of the cecum which is probably due to the extrinsic pressure or to adhesions by the mass. There is moderate redundancy of the sigmoid and both flexures.

Laboratory Findings. Urine. Specific gravity 1.018, very faint trace of albumin, acid reaction, occasional epithelium.

Blood. Hemoglobin 72 per cent, red blood cells 3,900,000, white blood cells 8100, polynuclear 70 per cent, small lymphocytes 24 per cent, large lymphocytes 4 per cent, large mononuclears 2 per cent, Wassermann negative.

The patient was admitted to the Royal Hospital for operation on July 30, 1935.

Operation. Under avertin anesthesia, an oblique intermuscular incision was made directly over the mass, two fingers medial to the anterior superior spine of the ilium. The skin and subcutaneous tissue were incised and the incisional margins retracted. Examination revealed this mass to be the size of a clenched fist, which by upward pressure had apparently dissected the aponeurotic layer of the external oblique muscle and rectus sheath. The incision was carried into the fibers of the aponeurosis and the layers were reflected. The lateral border was firmly bound at one point by adhesions to the right anterior superior spine of the ilium, and these were liberated with careful dissection. The underlying muscle fibers composing the rectus abdominal muscle were retracted on each side of the tumor to expose the pedicle. This was situated at the exit of the round ligament through the peritoneal layer where the round ligament had been pulled through to make the previous Crossen-Gilliam suspension of the uterus possible. The pedicle was cut between clamps applied to its most distal end and the stump ligated by transfixion suture. At no time was the peritoneum entered. The wound was closed by uniting the muscle fibers with plain

Fig. 1.

No. 2 catgut, the aponeurosis with interrupted sutures of No. 2 chromic catgut and the skin with a continuous locked suture of fine dermal suture material.

Pathological Report. The gross specimen consists of a mass of tissue the size of a small pear which is covered by a thin, rough, fibrous capsule. The mass is rubbery in consistency and on section is found to have a pale brownish gray appearance resembling smooth muscle in which numerous white glistening fibrous strands can be noted. There is no necrosis or hemorrhage present.

Microscopic Findings. The tumor tissue consists of bundles of cells and fibres running in various directions. The nuclei are spindle shaped, regular in size and shape, and stain evenly. The fibres are loose, wavy and in Van Gieson stain take a pink color. There are no mitotic figures or other evidences of malignancy. The tumor is moderately vascular.

Diagnosis. Soft fibroma (benign).

Postoperative Course. The postoperative course was stormy for five days with markedly elevated temperature, chills and sweats, yet thorough physical and laboratory examinations failed to reveal any abnormality. The wound healed firmly by primary union and the patient was discharged from the hospital on the twelfth postoperative day.

INCIDENCE

In the Woman's Hospital of New York City, from the beginning of 1918 to the end

of 1935, Dr. George G. Ward writes, "There had been 1147 operations for retroversion according to the technique of Simpson, Crossen, Gilliam and the modification of Mayo to these. There is no recorded case of a tumor developing in the round ligament following a retroversion operation." In a personal communication Dr. Thomas C. Cullen writes that in his clinic many extra-abdominal implantations to bring up the uterus have been performed but that he has never seen a tumor of the round ligament develop after such an operation. He states, "Of course there is no reason why one should not develop, because every now and then we find a tumor of the round ligament and this would doubtless develop just as well after operation as before."

ETIOLOGY

Here as elsewhere, we know little of the exact etiology of these growths. It is no more possible to account for the fibromyomata of the round ligament than for like growths in other muscular structures. Extra-abdominal tumors of the round ligament have been observed at any age previous to the menopause, although they do appear more frequently in the early part of adult life and more often on the right than on the left side. Pregnancy does not seem to have any etiological bearing. Menstruation seems to provoke a temporary increase in the size of the neoplasm. As long ago as 1883, Sanger believed that traction of a displaced uterus may play a causative role. The round ligament is derived from the distal part of the so-called inguinal ligament which the German call "Urnierenleistenband." It is inserted at the caudal part of the corpus Wolffi. Debris of the mesonephros may be retained in the inguinal region, and hence, may give rise to tumors which are histogenetically of nephrogenous origin, such as the extraperitoneal Wolff's tumor of the round ligament described by Hickel in 1923.

PATHOLOGY

The round ligament usually spreads over the tumor which is composed of unstriped muscle and connective tissue. The majority of these tumors are fibromyomata but like all fibromyomata, they undergo benign and malignant degeneration such as sarcomatous, lipomatous, cystic, lymphangiectatic and myxomatous. The operative findings of a dermoid cyst of the extra-abdominal portion of the round ligament was reported by Maccabruni. Adenomyomata of the round ligament occur. These are nodules which are found along the course of the round ligament most often near the external ring and form adhesions to the fascia; the masses may enlarge during menstruation. Their histology is similar to that of other adenomyomata. Tumors of the extra-abdominal portion of the round ligament present variable sizes varying from a small kernel to that of an infant's head, and most often are single. They are usually rounded or pyriform with a smooth surface. In rare cases they are elongated or cylindrical, having the form of a little finger. In a few cases, the tumors are multiple such as was reported by Lewis in 1903.

TREATMENT

The only treatment applicable to tumors of this type is early surgical extirpation.

SUMMARY

1. An extremely rare case of extra-abdominal tumor of the round ligament following uterine suspension is presented.

2. The etiology, pathology, symptoms and treatment of this condition are discussed.

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PYOSALPINX WITH TRAUMATIC RUPTURE*

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THIS case is reported because ruptured pyosalpinx is fairly infrequent, and this particular instance shows additional unusual symptoms in that (1) it was probably traumatic; (2) after the original operation the pus tube was not removed and still the patient made a complete recovery, and (3) a subsequent operation on account of lower abdominal pain after which she again fully recovered.

Mrs. C. H., married, aged forty-two years, housewife and janitress, complained of pain in right lower quadrant of the abdomen.

Present Illness. One day ago arose feeling well; later in the morning after carrying a heavy garbage can felt general abdominal pain which continued to noon of the next day. After the first few hours the pain was most marked in the right lower quadrant. She was nauseated but did not vomit.

Past History. There were no serious illness or operation. She has one child thirteen years old; no miscarriages. Her periods were regular, not associated with pain and occasionally a few days early.

Examination. Patient appears acutely ill. There is rigidity and tenderness over the whole lower abdomen, more marked in lower right side with rebound tenderness throughout, but no masses.

Pelvic Examination. The cervix is very soft; the uterus about the size of a three months gestation, exceedingly soft and well forward. A large tender mass about the size of a tangerine but not definitely outlined bulges into the right fornix. The mass is very tender on motion of the cervix. Nothing is felt in the left fornix. The rest of the physical examination otherwise is negative except that the temperature is 102.8°F.

Blood Count. Red cells 3,500,000; hemoglobin 60 per cent; color index 0.85; white cells 14,500, with eosiniphile 1 per cent; polymorphonuclear 82 per cent; bandform 2 per cent lymphocytes (large and small) 12 per cent; and mononuclears 3 per cent. The red cells showed slight poikilocytosis.

Preoperative Diagnosis. Acute salpingitis, acute appendicitis, acute diffuse peritonitis.

Operation. A right sided paramedian incision was made to open the peritoneal cavity and free pus found in the lower part of the abdomen. The right tube was tremendously thickened and edematous but with its fimbriated end opened and no pus expressible. Just beyond the junction of the tube and uterus, on the superior side of the tube was a perforation with a small area appearing to be necrotic. The right ovary and the left adnexa were normal. The uterus was about the size of a three and a half months gestation, exceedingly soft and boggy. The appendix was swollen, edematous and acutely inflamed but the inflammation gave the impression of having been introduced by contiguity rather than from the lumen of the organ. The small intestines and omentum were bound down by fresh fibrinous adhesions to the area in which the tube was perforated.

Appendectomy was done by the usual technique, amputating it with the cautery but not burying the stump. Two cigarette drains, one to the cul-de-sac of Douglas and the other one to the appendix stump were inserted passing the first drain in such a way as to be approximated to the tube at its perforation. The pus was sucked out of the belly and the abdomen closed.

Pathological Findings. Chronic obliterative appendicitis and acute periappendicitis, with no evidence of suppurative inflammation in the appendix.

Postoperative Diagnosis. Acute salpingitis with perforation of the right tube and acute metritis. The patient made an uneventful recovery and was discharged from the hospital on the twenty-eighth day of her stay.

Note. It may be of interest to mention that the patient was operated for fibrosis of the uterus a year and a half later with removal

* Read before the American Hungarian Medical Association at the New York Academy of Medicine, May 3, 1934.

of the right tube and the uterus. Part of the pathological findings reads: "The right tube measures 11.5 cm. long, 0.6 cm. in diameter. The fimbriated end is patent. The wall and mucosa show no gross changes. At the utero-tubal junction there is a large cyst measuring 3 cm. in diameter which is reddish brown in color. On opening it is found to contain a brown fluid. Its inner surface is smooth, glistening and gray in color, covered with yellowish granules. It appears to be a dilatation of the lumen of the tube."

DISCUSSION

Etiology. This case was apparently traumatic, i.e., the rupture occurred while the patient was carrying a heavy garbage can. There are various causes mentioned in the literature, as physical exercise, violent coitus, falls, etc., and it may even be due to defecation, as happened in Brickner's[1] case. Constandulaki[2] in 1930 could gather only 5 traumatic cases of 44, and in 1933 Toudjarowsky[3] says that the traumatic occurrence is very rare, simple perforation being the rule. "He presents Lubke's cases which divide into 5 sterile, each of 2 gonococci and staphylococci, 1 Koch, 4 streptococci of which 2 died, and 7 coli bacilli with 5 deaths . . . "; 13 not examined cases of which 7 died. All the others recovered.

Symptomatology. Pain which localizes on either side of the abdomen is usually the chief complaint. Nausea is a frequent symptom and if not associated with vomiting is quite characteristic. Abdominal tenderness and rigidity are usually present. Vaginal examination, because of the severe pain does not yield much information, but occasionally a mass or fullness is felt in either fornix. This finding is a valuable aid in the diagnosis. The patient may be in shock, with pallor, rapid and thready pulse. Suspicion should be aroused when pain and tenderness is low down in the iliac region with a history of recent gonorrhea, recent pregnancy or uterine instrumentation.

Differential Diagnosis. The difficulty of differentiating from acute appendicitis is recognized. The main differential point is the more acute symptom in a ruptured tube, the lower location of the pain and the mass in the fornix, if found. In spite of the rarity of the condition it must be borne in mind because an early diagnosis is of vital importance. If operated with in the first twelve hours the surgeons report a mortality varying from 10 per cent to 27 per cent; but including all cases operated within twenty-four hours the reported mortality varies from 13 per cent to 66 per cent.

Treatment. It is unanimously accepted that immediate laparotomy must be done. But the opinions are divergent regarding the further steps. The various methods after opening the abdomen are: (1) simple abdominal or vaginal drainage, or both; (2) unilateral extirpation of the ruptured tube; (3) bilateral extirpation and (4) total or partial hysterectomy. There seems to be one definite rule: no extirpation should be performed unless the patient's condition allows it. According to Sabadini[4] even then the chances are just as good with removal as without it. He is not enthusiastic about removing any of the organs but is strongly in favor of Mikulic drainage. Adequate drainage is a primary consideration.

SUMMARY

1. A case of ruptured pyosalpinx, probably traumatic, is presented.

2. The importance of early diagnosis is stressed because of the rapid increase in mortality when operation is delayed.

3. Operation is the only treatment.

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URINARY DIASTASE TEST IN PEPTIC ULCER PENETRATING INTO PANCREAS

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ONE of the common complications of peptic ulcer is penetration into an adjacent structure and frequently the pancreas. Ulcers that have penetrated into the pancreas do not always respond well and are considered generally as surgical. The erosion into the pancreas undoubtedly causes an escape of the pancreatic ferments into the ulcer area, and is probably a potent factor in perpetuating the ulcer through digestion of the stomach tissue. This causes a vicious circle, usually difficult to break with ordinary measures and may require more radical treatment. Hinton[1] believes that when a peptic ulcer patient shows pancreatic involvement, surgical treatment should be instituted as soon as the diagnosis is made. He used the amylase and lipase test of the blood serum and decided it was of no value in diagnosis, depending mainly on the history. Cohen[2] found the urinary diastase normal in 2 cases of ulcer penetrating the pancreas. Lasch[3] found an increase in the blood lipase in 4 cases. Block[4] says that a definite increase in the blood amylase speaks for a penetrated pancreas. Grassberger[5] could not draw any conclusions from the lipase and diastase values in the blood.

The quantitative determination of the diastase in the urine is a relatively simple procedure. We used a modification of the Wohlgemuth[6] method. The urine was diluted 1:25 in normal saline, using a 1:1000 starch solution, mixing varying proportions of each and then incubated at 37°C. for thirty minutes. A drop of tincture of iodine is then added; a blue color denotes the presence of unchanged starch while a brown or purple brown color shows that the starch has been broken down. The amount of diastase in each tube is calculated in units. A unit of diastase is that amount necessary to reduce 1 c.c. of 1:1000 starch solution. The accepted normal values are 6 to 30 units per c.c. of urine. In our determinations, we made no effort to correct the acidity to meet the optimal *p*H of diastase activity, which is 7.2. If our results are slightly inaccurate because of this, they are too low. Our positive results would therefore still remain elevated values.

CASE REPORTS

CASE 1. J. H., male, aged forty-one, was first seen in March, 1935 with a history of upper abdominal pain and fever of eighteen months duration. The pain was of rather sudden onset in the epigastrium radiating to the right upper quadrant, persisted during the day with frequent nocturnal exacerbations. Recurrent chills and fever accompanied the pain which lasted for seven weeks. He had practically no pain or fever for the next ten months. From November, 1934, until he was first seen in March, 1935, he had slight intermittent fever. Pain in the epigastrium recurred March 12, 1935, was constant and radiated to the right hypochondrium and occasionally through to the back. The pain was not influenced by meals. Since then, he had occasional exacerbation of the pain, usually with slight fever. He had a mild cough for many years with very little expectoration.

Examination of the chest showed numerous subcrepitant rales throughout, more pronounced in the bases. The heart was normal. The liver was palpated two fingers breadth below the costal margin, with a smooth hard edge. The upper border of the liver dulness was at the sixth rib. There was moderate tenderness in the epigastrium and right upper quadrant.

Blood examination showed hemoglobin 75 per cent, red blood cells 4,800,000, and white blood cells 10,100. The differential smear showed polymorphonuclears 65, eosinophile 1, basophile 1, small lymphocytes 17, large lymphocytes 14, monocytes 2. The Ewald test meal showed 50° free and 68° total acidity. Roentgenologic examination showed the chest to be normal, the diaphragms regular and moved freely in the anteroposterior and lateral views. The stomach showed a definite deformity of the bulb with prepyloric spasm on the lesser curvature side. A clinical diagnosis was made of probably an old penetrated duodenal ulcer with a perigastric inflammatory process which was reactivated from time to time.

The patient was placed on a modified Sippy regime, but as he did not adhere to medical management, did not do well. Reexamination roentgenologically in September, 1935, showed the prepyloric deformity to be very suspicious for a filling defect. He was operated elsewhere but no evidence of any lesion in the stomach or duodenum was found. The abdomen was closed without opening the organs because of the condition of the patient. He developed an extensive bilateral bronchopneumonia and had a mild evisceration on the sixth postoperative day. He later developed a lung abscess with gangrene and empyema of the right pleural cavity. Bedsores developed in the usual locations but gradually became more numerous over the back and assumed a deep crater appearance with sharp edges. Apparently the subcutaneous fat was involved in the ulceration. These ulcers were similar to those in a case presented some time ago at the Cook County Hospital in which Jaffe showed the lesions to be due to circulating pancreatic enzymes. A urinary diastase determination was done on our patient and revealed 250 units per c.c. of urine, which was interpreted as definite evidence of a pancreatic lesion. It is possible that the evisceration may have been due in part to digestion of the sutures by the pancreatic enzymes.

The patient died after a six weeks' stormy postoperative course. Necropsy revealed essentially that there was an extensive bilateral bronchopneumonia with abscess and gangrene in the right lower pulmonary lobe, and an empyema of the right pleural cavity. On the posterior wall of the duodenum was a peptic ulcer 2 × 3 cm., adjacent and adherent to the head of the pancreas which was indurated. At the base of the ulcer could be seen portions of pancreatic tissue. There was a slit-like opening at the base of the ulcer which had eroded into the pancreaticoduodenal artery. There was fresh blood in the stomach and bowel.

Case II. J. F., a male aged sixty-four years, was first seen in June, 1935, with a five year history of hunger pain, frequent vomiting and nocturnal pain typical of duodenal ulcer. Roentgenologic examination showed a definite deformity of the bulb, with slightly delayed emptying time of the stomach. The Ewald test meal showed 40° free and 50° total acidity.

The patient was on a fairly strict modified Sippy management without improvement, and the pain became almost uncontrollable. He was given gastric mucin for three weeks, in addition to the milk and cream every hour, with no improvement. During a course of twenty-four injections of larostidin, the pain was considerably relieved. We are not drawing conclusions in this case as to cause and effect. A urinary diastase test done just preceding the larostidin treatment showed 100 to 149 units per c.c. of urine. One week later, the diastase value was less than 12 units. Toward the end of the larostidin injections, the day after much nocturnal pain, the test showed 100 to 149 units of diastase.

Case III. L. H., male aged thirty-seven years, was first seen in December, 1934, giving a typical history of duodenal ulcer and frequent nocturnal pain of one year's duration. There was much belching and distention in the upper abdomen after meals. Pain across the lumbar region had been present for three years occurring only during the night and was frequently accompanied by dull pain in the midepigastrium. Roentgenologic examination showed a definite deformity of the bulb. The Ewald test meal showed 40° free and 55° total acidity. On mild medical management, he was free from epigastric pain until October, 1935, since when the pain is not as readily relieved by food. Nocturnal pain in the epigastrium is very pronounced. The lumbar pain is more frequent recently, and is usually accompanied by epigastric pain. The urinary diastase test showed 50 to 99 units per c.c. of urine.

CONTROL CASES

Of urinary diastase determinations done on 5 cases with duodenal ulcer doing well,

2 showed 12 to 24 units, 2 showed less than 12 units, and one showed slightly more than 25 units. These values are all within normal limits. One patient with a chronic pancreatitis, but not ulcer, who had had an acute attack one year previously, verified by operation, showed a diastase value of 100 to 149 units and 150 to 199 units on different occasions. Unfortunately, our present series does not include ulcer patients with uncontrollable pain, with and without pancreatic involvement, who have normal diastase values.

Mushin[7] has applied the urinary diastase test to 140 patients with conditions other than pancreatitis, verified by operation or postmortem. The values varied from 2 to 32 units. In 26 cases of acute pancreatitis, the values varied from 50 to 4100 units.

CONCLUSIONS

In patients with definitely elevated urinary diastase values, we must conclude that the pancreas is damaged. In patients with peptic ulcer, especially those not doing well, who show evidence of pancreatic damage, we have at least presumptive evidence that the ulcer is penetrating into the pancreas. Peptic ulcers and pancreatitis occur independently without direct extension, but in ulcer patients with uncontrollable pain and *x*-ray evidence of a lesion in the duodenum or pyloric end of the stomach, we can make a probable diagnosis of penetration into the pancreas. We realize that our series is far too small to judge how frequently we may expect elevated diastase values in such cases, or in what stage of the process of penetration we may or may not expect elevated values. We hope to determine these facts through further work. A negative result cannot be evaluated but we believe a positive result to be of definite aid in diagnosis.

The determination of pancreatic involvement as a complication of ulcer may explain many unusual symptoms that accompany an ulcer syndrome, and may also serve as a better guide to treatment. Patients with a hemorrhage from an ulcer, who show pancreatic involvement, might do better surgically, before waiting for repeated hemorrhages.

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TRAUMATIC RUPTURE OF DIAPHRAGM

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STATISTICS compiled by numerous authors show that a vast majority of diaphragmatic hernias are congenital and generally do not live more than a few hours to a few days. Acquired hernias of the diaphragm develop as a result of a defect of the diaphragm and this defect is usually at the esophageal hiatus. A great many authors have doubted that trauma plays any part in diaphragmatic hernias. In the case reported it is shown that the rent is not at the site where the defects are usually found. This patient enjoyed good health the first seventeen years of her life. The onset of her trouble was immediately following a severe abdominal injury which was believed to be a true rupture of the diaphragm produced by trauma.

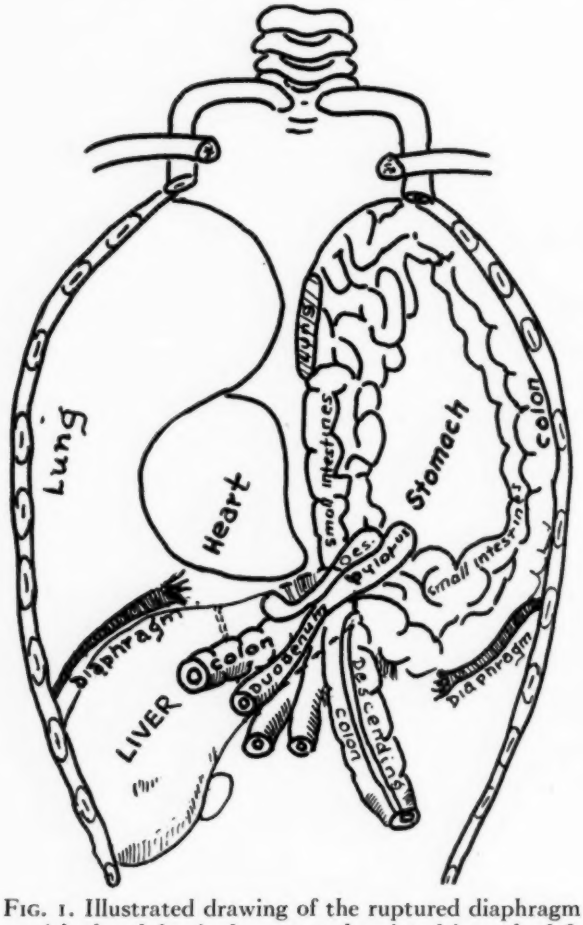

FIG. 1. Illustrated drawing of the ruptured diaphragm with the abdominal contents herniated into the left chest.

CASE HISTORY

Mrs. C. B. S. Twenty-two years old, housewife complained of "Ulcer of the stomach," loss of weight, indigestion, severe pain in the epigastrium and "fainting spells."

The past history revealed no acute illness of any consequence and no operations.

Present Illness. She sustained a severe abdominal injury in an automobile accident in September, 1930 and was confined to bed for three weeks. Since then she has had repeated attacks of substernal pain, generally at night and usually relieved by walking. Immediately following the accident, she claims that she felt numb all over, had fainting spells and dizziness and would suffer severely all night. At times this would be better but was more or less continuous and had been diagnosed as ulcer of the stomach and appendicitis and had been treated by several physicians in various places. She was also thought to have had some cardiac disturbance. No *x*-ray work had been done. Mrs. S. came under my observation on May 28, 1935, with the above history.

Physical Examination. She was five feet, two inches tall and weighed 80 pounds, blood pressure 118 systolic and 70 diastolic. No rales or murmurs were heard. All the reflexes were normal. Her abdomen was considerably retracted and very tender over the lower right quadrant. Urinalysis normal. The total red cell count was 4,000,000 with 90 per cent hemoglobin, and white cells 6350. Gastric analysis showed a high acidity. At this time she was advised to have a *x*-ray series of the gastrointestinal tract but failed to have this work done.

Treatment. She was placed on a diet and given alkaline powders, which she claimed greatly improved her condition. She was not heard from again until December 14, 1935,

Fig. 2. *X*-ray showing relationship of the esophagus and the displaced stomach.

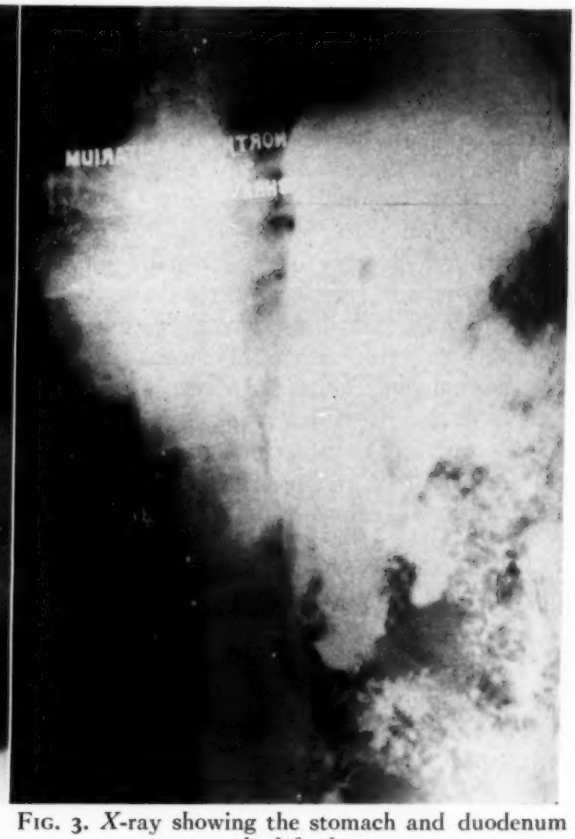

Fig. 3. *X*-ray showing the stomach and duodenum in the left chest.

Fig. 4. Six hour *x*-ray showing the stomach empty and barium in the small intestines and colon.

Fig. 5. *X*-ray showing the stomach in normal position in the abdomen twenty-three days after operation.

when she presented a grave picture, with board-like abdomen and severe pain which morphine failed to relieve. She was brought to the sanitarium and a diagnosis was made of a possible ruptured ulcer of the stomach. An exploratory operation was done and the appendix was removed. The stomach, small intestines and transverse colon were found to be in the left chest through a very large rupture of the diaphragm which freely admitted the whole hand. Knowing that the patient at that time was unable to stand repair of the diaphragm, the abdomen was closed. After about two weeks, a gastrointestinal *x*-ray series showed the stomach, small intestines and transverse colon herniated in the left chest.

Preoperative Treatment and Operation. For forty-eight hours prior to operation the patient was allowed nothing by mouth but glucose and saline was given by infusion. On January 2, 1936, the operation was performed under gas, ether and oxygen, with the safety device which made it possible to deflate or inflate the lungs at will. The abdomen was opened from the xiphoid process to nearly the umbilicus, severing the left rectus muscle at right angles, extending this incision at its upper portion and severing the sixth and seventh left costal cartilages obtaining a good exposure of the diaphragm with large retractors. The 5 inch rent in the diaphragm extended from the dome of the right laterally to the dome of the left of the diaphragm and anteriorly to the esophageal hiatus, with no sac. The left lobe of the liver was adherent to the diaphragm and was herniated into the mediastinum. The stomach, transverse colon and small intestines were all found to be in the chest. Under positive pressure, the abdominal contents were forced out of the chest. The abdomen being retracted, it was rather difficult to have room for these organs. However, in the Fowler position the contents were packed into the abdomen with large sponges, the lungs were inflated and the opening in the diaphragm was then sutured with black silk, using five interrupted stitches. The margins of the hernia being approximated and a continuous running suture of black silk thread reinforced the approximation line. The peritoneum was closed with No. 2 plain catgut suture. The costal cartilages were sutured with No. 2 chromic catgut and the section muscle with No. 2 chromic mattress suture. The fascia was closed with No. 2 chromic, and interrupted silkworm and continuous dermal suture was used for the skin.

Postoperative Treatment. Glucose and saline were given by infusion, a duodenal tube with suction decompression was kept in for seventy-two hours and the colon tube was also used. Nothing was given by mouth except water which was siphoned off continuously along with other gaseous material. She received about 3000 c.c. fluid per day by infusion. Every six hours the lungs were inflated with CO_2.

She had an uneventful recovery, leaving the hospital January 15, 1936, thirteen days postoperatively.

CONCLUSION

1. It did not seem necessary to do cecostomy in view of the fact that the intestional tract was entirely empty and by the use of the decompression duodenal tube the gas distention was eliminated. The colon tube also aided in elimination of gas.

2. By severing the sixth and seventh costal cartilages in this type of abdominal incision, the ribs were retracted more freely, giving better access to the diaphragm.

3. In hernias as large as this, the heart and pericardium can be protected from the possibility of suturing by using the fingers of the left hand as a protector.

4. It was not deemed wise to crush the phrenic nerve in view of the fact that the rent in the diaphragm extended across from the dome of one side to the dome of the other. The sutures would thereby include some of the branches of the nerve on either dome, partially paralyzing the nerve.

ASPIRATION FOR ACUTE EMPYEMA IN ADULT

CASE REPORT

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IT IS generally taught that the treatment of acute empyema by aspiration is applicable only to young children, and only in selected cases.

However, I successfully treated by aspiration a boy of seventeen who was acutely ill with empyema. Because of his desperate condition, rib resection was contraindicated at the time, and aspiration was resorted to in the hope of tiding him over until he could be operated. However, aspiration by itself resulted in complete recovery so that rib resection proved unnecessary.

CASE REPORT

R. G., aged seventeen years, white male, was admitted to the hospital November 11, 1932 with an acute respiratory infection.

His illness had begun as an acute rhinitis about two weeks before his admission to the hospital and had developed into an upper respiratory infection. Within a week he had had pain in the right side of the chest on breathing, had raised blood-streaked sputum, had had a chill and a rise of temperature.

On admission to the hospital he was acutely ill; his temperature was 100.4°F., pulse 96, respirations 30 and shallow. His cough was productive of large quantities of sputum, culture of which showed an abundant growth of streptococci. Clinically he had an acute pneumonia of the right lung.

X-ray films showed a pneumonic process involving the entire right lung field and the left central lung field together with a pleural effusion on the right side.

Attempts by the interne, two days and again five days after the patient's admission to the hospital, to aspirate fluid from the right pleural cavity resulted in his obtaining only a few drops of blood.

During the first eight days of the patient's hospitalization his temperature hovered close to 102.5°F. During the following week his temperature fluctuated between 100°F. and 104.2°F. By the tenth day after the patient's admission to the hospital the pneumonia seemed to be resolving.

However, *x*-ray examination of the lungs, November 23, showed a homogeneous veiling over the entire right pulmonic field, interpreted as a pleural exudate.

When I first saw the patient, November 25, I made a diagnosis of empyema of the right pleural cavity, but as the patient was too ill to be operated, it was deemed advisable to aspirate the pus in an attempt to tide him over to a less acute stage of his illness. Sixteen hundred cubic centimeters of greenish grey, rather thin pus were removed very slowly from the right pleural cavity at the midaxillary line in the sixth interspace, and an equal quantity of air injected. Cultures of the pus showed a pure growth of staphlococcus aureus. The lateral *x*-ray films of the lungs, taken four days later showed three separate empyema pockets on the right side; one extended from the apex to the sixth rib in the anterior half of the field; a second extended from the sixth to the eighth rib in the anterior field; and a third occupied the entire posterior half of the field from the posterior costophrenic angle to the apex. The anterior superior pocket was empty. The posterior pocket was half filled with exudate and showed a horizontal fluid level. Aspiration was done again.

Meanwhile blood transfusions were advised but as the patient was an atypical type IV by the Moss classification no compatible donor could be found.

On November 29, 300 c.c. of moderately thick, brown pus were removed through the eighth interspace at the angle of the scapula, thus draining the posterior pocket. Cultures of the pus showed an abundant growth of Staphylococcus aureus. Following this aspiration the patient's temperature came to normal and remained normal for the remainder

of his residence in the hospital. He looked and felt very much better.

X-ray films taken December 1 showed the anterior superior pocket still empty. The posterior pocket was one-third full, and the pocket at the anterior costophrenic angle still contained pus. On the same day 250 c.c. of moderately thick, brown pus were aspirated from the posterior pocket through the ninth interspace just medial to the lower angle of the scapula.

X-ray films taken December 5 showed the anterior superior pocket still empty; a very small quantity of pus in the posterior pocket and no change in the pocket at the anterior costophrenic angle. On the same day I aspirated 120 c.c. of bloody pus from the posterior pocket through the tenth interspace in the midscapular line.

After each aspiration I injected a quantity of air equal to the amount of pus removed.

X-ray films taken December 7 showed no evidence of either free or encapsulated exudate in the right pleural field. There was a marked homogeneous veiling over the lower half of the right chest probably caused by a plastic pleurisy. The diaphragm was slightly elevated; the heart and other mediastinal contents were not displaced.

Further *x*-ray films taken December 17 showed practically the same condition.

The hemoglobin which had dropped as low as 59 per cent (Sahli) on November 12, was 75 per cent on November 28.

The patient was discharged from the hospital December 18, 1932. At that time the right chest was clinically clear except for slight dullness at the anterior right base.

Merely because of this one successful case, I do not by any means advocate the method of aspiration for empyema for all patients, but I do advocate always considering it and even trying it before resorting to rib resection.

SUMMARY

An adult patient very ill with pneumonia and empyema was cured by aspirations of three pockets of pus. After each aspiration a quantity of air equal to the quantity of pus removed, was injected into the cavities.

CONGENITAL ABSENCE OF GALL BLADDER

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CONGENITAL anomalies of the gall bladder are rare. Gross[1] lists 38 cases of absence of the gall bladder attended by no other anomaly and in a series of 200 cases of atresia of the extrahepatic bile passages he finds 35 cases of associated gall bladder absence. Agenesis of the vesica fellea may occur without any variation of the remaining extrahepatic anatomy. A poorly defined or absent quadrate lobe of the liver is a frequent concurrent finding. No impairment of health or disturbances of the digestive functions result from such an anomaly. Such compensatory dilatations as occur in the hepatic or common ducts are not due to the absence of the gall bladder but to obstruction from biliary calculi. Gross found that absence of the gall bladder is twice as common in females as in males.

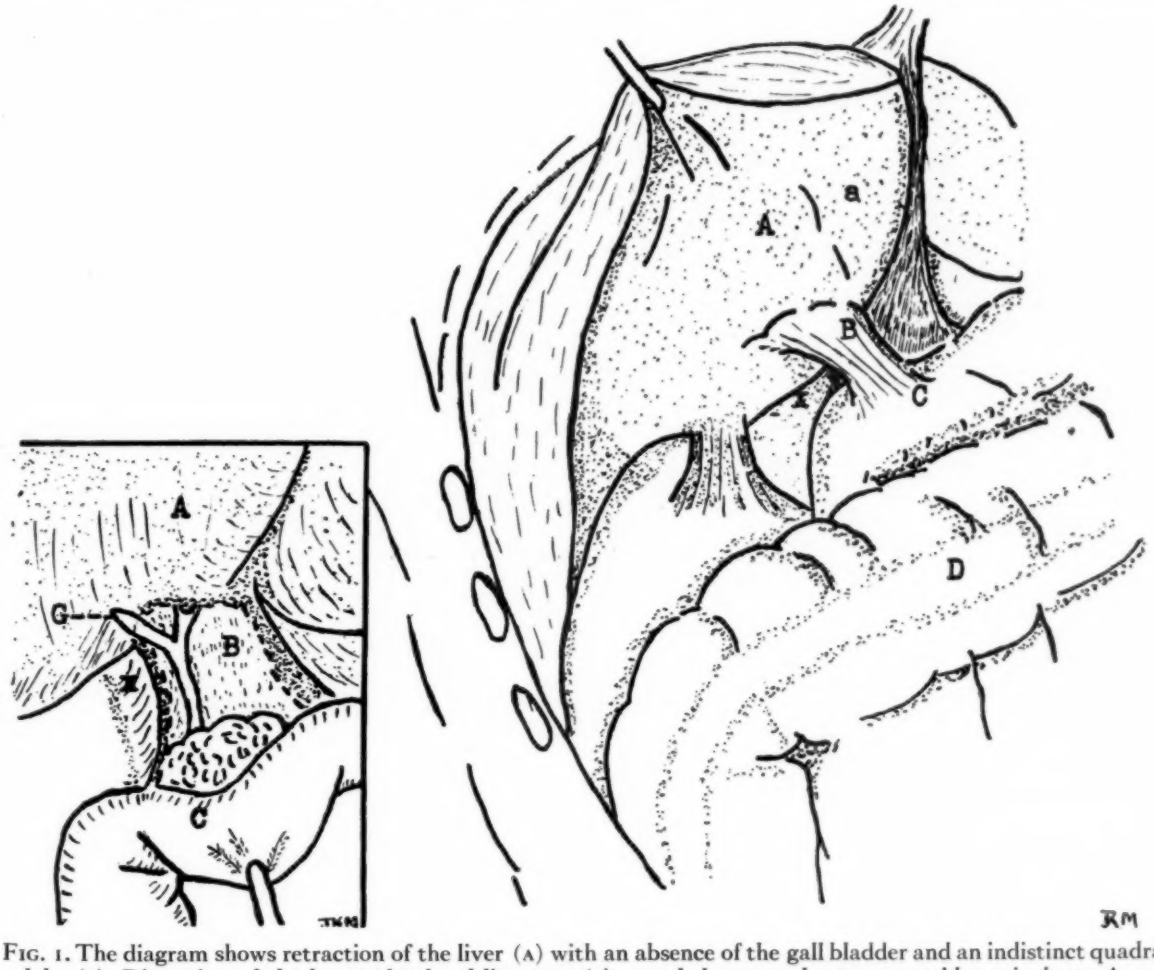

FIG. 1. The diagram shows retraction of the liver (A) with an absence of the gall bladder and an indistinct quadrate lobe (a). Dissection of the hepatoduodenal ligament (B) revealed a normal common and hepatic ducts. A small duct in the region of the cystic duct is seen (G); duodenum (C); transverse colon (D); foramen of Winslow (X).

Congenital absence of the gall bladder may be due to agenesis of the bud or offshoot from the hepatic diverticulum of the foregut or failure of this gall-bladder bud

to develop from its solid embyronic state into a tubular structure. Excepting the common duct, the entire duct system including the gall bladder, is first constructed of solid cords of cells which later acquire their lumina. Atresia and stenosis of the duct system have their genesis in the normal embyrologic history, since for a time the passages are solid; the normal transitory condition simply persists. Hence, when there is atresia of the extrahepatic system there is usually a demonstrable cord of tissue. Its absence suggests an agenesis of the embyronic bud.

P. C., a very obese, eighty-four year old white male, was a patient with arteriosclerosis with psychosis. No history of gastrointestinal or biliary complaint was ever elicited. Death was due to myocardial failure.

Autopsy Findings. The abdomen showed no scars. Retraction of the right lobe of the liver revealed an absence of the gall bladder and the outlines of the quadrate lobe were indistinct. The hepatoduodenal ligament ended in a mass of fibrous tissue, 2.5 cm. by 1 cm. by 5 mm. Dissection of this mass revealed a tubular structure, 2 cm. by 3 mm. in diameter. The blind end of this tube contained a small gall stone. The open end of the tube joined the hepatic duct to form the common duct.

The duodenum presented a mild inflammatory reaction and contained some bile stained fluid. The pancreas was twice normal size and appeared firmer than usual, the cut section revealing a few islands of parenchyma scattered throughout a diffuse mass of fibrous tissue.

Microscopic examination showed a mass of loose fibrous tissue containing blood vessels and nerves. A semicircle of young fibrous tissue and round cells were seen on a base of mature fibrous tissue which contained numerous strands of muscle fibers. The inner layer of fine fibrous tissue suggested in places, degenerated mucosa.

SUMMARY

A case of congenital absence of the gall bladder in an eighty-four year old white male, is reported. The agenesis is presumed to be a failure of the gall-bladder bud to resolve from its solid embryologic stage, because of the presence of the remnant of tubular tissue in the fibrous tissue at the hepatic end of the hepatoduodenal ligament.

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BACTERIOPHAGE TREATMENT OF TYPHOID FEVER CARRIER WITH BONE ABSCESS

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IN an active bone and joint and orthopedic practice of over thirty years, 9 post-typhoid bone abscesses of the spine have been seen. This is the first found in the tibia or any long bone, and also the first instance where the bloodstream, urine, bile and stool have proved to be infected with the same organism. Whether, in this instance, the bloodstream infection came via the bone lesion, it is difficult to say. However, Alessandrini and Doria demonstrate that typhoid fever is associated with a bloodstream involvement and because of this, it is always advisable to administer a bacteriophage not only by mouth but also intravenously.

Previous to 1904, there had been repeated outbreaks of typhoid fever in Strassburg, Germany, which Koch traced to a certain bakeshop. Upon investigation that he found the bakery was in every respect clean and the water supply pure, but the woman who ran the shop admitted that years before she had been ill of typhoid fever. Tests revealed that, although she seemed in good health and was able to go about her business, her excreta showed the presence of typhoid bacilli. By this case the carrier principle was proved for the first time by Koch.

In 1904, Dr. George A. Soper, of the Department of Health of New York City, was puzzled by repeated outbreaks of typhoid fever in homes where the food and water supply were above suspicion. The most outstanding of the outbreaks were in Mamaroneck in 1900, and in a home in Dark Harbor, Maine, where seven members were affected. In 1904, typhoid broke out in individual homes in Sands Point and Oyster Bay, Long Island and Tuxedo Park. Dr. Soper, in investigating these outbreaks, observed a peculiar fact that in all of these places at the time of the typhoid visitation, a Mary Mallon, competent and clean looking, had been employed as cook. In 1907, Dr. S. Josephine Baker, of the Child Hygiene Bureau of the Health Department of New York City, had to forcibly remove Mary Mallon to the Willard Parker Hospital, from a home where she was very popular with her employer as well as her fellow servants.

Tests showed that there were many typhoid bacilli about her, and that any food she might prepare would be likely to be contaminated. The gall bladder was found to be badly infected, but all attempts at persuasion failed to induce the dangerous, stubborn cook to have her gall bladder removed. She was sent to North Brother Island, where she was committed, virtually a prisoner.

In 1909, she appeared before the State Supreme Court demanding release from her forced confinement, which she claimed was that of a leper. The court decided against Mary and she was sent back to the Island. Finally, after three years of constant fighting, on February 19, 1910, Mary was freed with the promise on her part that she would never handle food as a servant.

For a time she apparently complied, but in 1914, four years after her release, typhoid broke out in a sanitarium in Newfoundland, New Jersey, where it was found that Mary had worked as a cook, but she escaped before she could be caught. A severe outbreak then occurred at the Sloane Maternity Hospital in New York where of 285 patients, 25 were infected, 2 dying of typical typhoid fever. Mary, under the name of Mrs. Brown, was found serving as cook.

On March 27, 1915, the New York Health Department sent Mary back to North Brother Island, which proved to be a lengthy stay, and she became a laboratory helper. She later had a stroke of apoplexy.

She was the first authentic typhoid carrier in this country, and according to Walker, has an official record of having caused 51 cases of typhoid fever with 3 deaths but how many others might be attributed to her is unknown.

It is not known how many carriers there are at large but Walker in The New Yorker, January 1935, states that there were at that time, 344 in New York City alone. The remarkable persistence of the bacilli to perpetuate themselves in such cases is illustrated by Mary. She was first observed in 1904, ten years later caused an outbreak and, as far as is known, may be a carrier today, twenty-one years after being definitely proved to be one.

Mr. E. F., aged twenty-eight years, was admitted to the Florida Medical Center, on December 29, 1934, complaining of pain over the middle third of the left tibia of two weeks' duration and some swelling and local elevation of temperature. Ten days prior to his admission, the pain had increased, was constant and seemed worse while walking. For three or four days before hospitalization, the pain had been so intense, that he was unable to rest at night.

Examination revealed a definite point of tenderness and pain over the middle third of the left tibia, which on *x*-ray examination was diagnosed as a small subperiosteal abscess.

He had been admitted to the Harper Hospital on July 24, 1934, with a history of headache, malaise, diarrhea, fever, pains in back, arms and in the epigastrum, of twelve days' duration and an admission temperature of 103°, pulse 86, respiration 20. Physical examination revealed the tip of the spleen to be palpable and a mild abdominal distention.

For twenty-one days the patient ran a persistent temperature of 103°–104° and a pulse rate between 80 and 100. The temperature then dropped to 100°, only to have a relapse, reaching 104° two days later, and remained high for eleven days more, then undulating with a spiking temperature ranging from 100° to 103° and pulse from 90 to 126 daily, for a period of twenty-eight days, at which time the temperature was 99°. He remained practically afebrile from then, until he was discharged on October 17, twenty-three days later, after almost three months.

Among the patient's complications should be noted a rigidity of the neck and somewhat lethargic mental state appearing on July 27, and persisting for about ten days. There was no Kernig or other neurological findings. On August 7 the patient manifested twitchings of the hands and muscles of the face, and the following day, an active delirium, extreme restlessness and vomiting. This neurological picture was absent on August 13. At this time, he presented a diffuse rash, with rose spots, over his abdomen.

On August 14, bright red blood was noted in the stools, which continued for approximately one week and then traces for three days. During the time of this intestinal hemorrhage, the patient looked acutely ill with a drawn facies, restlessness and some abdominal distention and tenderness across the lower abdomen. Surprisingly the pulse remained of fairly good quality, though the patient had developed a profound anemia with a red blood count of 1,770,000 cells and hemoglobin of 45 per cent. The white blood cell count at this time was 2200, and showed a leukopenia ranging from 3000 to 5000 during this full period of his first hospitalization.

On August 31, he developed a tenderness over the spleen, which became quite distressing for a few days, the spleen being palpably enlarged with a questionable friction rub over it. A diagnosis of perisplenitis was made.

On September 27, he had a localized tenderness and pain over the eighth rib anteriorly, which was believed to be a periostitis with possible low grade osteomyelitis. There was no associated pain beneath the costal margin or discomfort in breathing.

Other incidental complications were the development of an impetigo over the patient's nose and face, and the presence of a small acute thrombotic hemorrhoid. The latter was excised under local anesthesia.

Physical condition was considered very good on discharge from the hospital, with no evidence of any existing or impending complications.

As to the laboratory work at the Harper Hospital, the patient had a secondary anemia

all through his illness, the highest recorded count being 3,620,000 red blood cells and 60 per cent hemoglobin, which was taken shortly after admission, and was exactly duplicated on discharge, although in the interim, his count averaged 2,000,000 even reaching as low as that previously recorded at the time he was showing gross blood in his stools. The lowest white blood cell count was 2200 with 52 per cent polymorphonuclear cells and 48 per cent lymphocytes. Urinalyses were essentially negative throughout, except for the appearance of 8 to 10 leukocytes per h.p.f. from September 7 to 10 inclusive. Patient had a positive Widal through all dilutions of Bacillus typhosus, as well as positive stool and gall-bladder cultures. There is no record of a positive urine or blood cultures. On two occasions a Gram positive bacillus and Staphylococcus albus were found in the blood cultures, though the laboratory considered these as contaminations. The patient's serology, Wasserman and Kahn, were negative.

On December 30, 1934, the patient was operated at the Florida Medical Center, the subperiosteal bone abscess being saucerized, drained, scraped thoroughly and packed with gauze saturated with a compound consisting of paraffine 90 per cent and yellow vaseline 10 per cent at 120°F. A culture proved to be typhoid. In view of his previous history of typhoid fever, further investigations were begun immediately.

On January 1, 1935, a culture from the leg wound showed a motile bacillus which was determined culturally to be Bacillus typhosus, eberthella typhi. On January 3, a culture from the bladder urine showed a streptococcus and a motile organism, which last was determined culturally to be Bacillus typhosus and an agglutination, or Widal, test made of these cultures with a known immune serum was positive, as was an agglutination test made of the cultures with the patient's own serum. Also, on the same date, a Widal test using the patient's serum and stock cultures of Bacillus typhosus and paratyphoid bacillus A and B were positive for all organisms. On January 7, the examination of a venous blood culture taken January 3 showed a motile bacillus which was also determined culturally to be Bacillus typhosus and the bile culture showed a staphylococcus and a motile bacillus which were determined culturally to be Staphylococcus aureus and Bacillus typhosus.

On January 8, intravenous and local treatments with a laboratory bred specific typhoid bacteriophage* were started, using it in asparagin media. The complete details of the treatment and time is outlined in the following:

Intravenous Bacteriophage			Local Applications to Leg	
Date	Amount		Reaction	Amount Undiluted, Cubic Centimeters
	1–10 Dilution, Cubic Centimeters	Undiluted, Cubic Centimeters		
1935				
Jan. 8.				
9:30 A.M.	2	...	None	
2:30 P.M.	5	...	None	2
Jan. 9	..	1	Slight	2
Jan. 10	..	.8	Very mild	2
Jan. 11	..	.7	None	2
Jan. 12	..	.8	None	5
Jan. 14	..	1	None	
Jan. 15	..	1	None	
Jan. 16	..	1.1	None	
Jan. 17	..	1.2	Slight	1
Jan. 18	..	1.2	None	
Jan. 19	..	1.4	None	
Jan. 20	..	1.8	None	
Jan. 21	..	2	None	
Jan. 22	..	1	None	5

It will be noted from the chart that on January 22 the last of the bacteriophage was given. On January 23, a complete check of the bile, urine, stool and blood was made and all proved to be negative. The patient was discharged from the hospital with instructions to return in three weeks for another check. This he did on February 14, 1935, at which time all four specimens proved to be negative for the typhoid bacillus. He was asked to return again on March 23, and nearly one year later, namely, December 28, 1935, for additional checks and at these times, all specimens again proved to be negative. Viz:

Blood cultures made in meat infusion broth, negative for Bacillus typhosus after 5 days incubation.

Urine cultures made in meat infusion broth, negative for Bacillus typhosus after 5 days incubation.

Urine cultures made on nutrient agar slant, negative for Bacillus typhosus after 5 days incubation.

* McNeal, Ward J., M.D. "Specific Treatment of Septic Infections, Particularly with Aid of Bacteriophages." *American Journal of Medical Sciences*, Volume 187, May, 1934.

The laboratory work on these examinations of bile, urine, blood and stool following the last administration of the phage was identically the same as that which was done on January 1, 3, and 7, 1935.

In reporting this case, it is realized that one case does not make a clinic, yet, at the same time, it is interesting to note that here is a known typhoid carrier with typhoid periostitis and bone abscess who has been bacteriologically and culturally cleared entirely by the use of bacteriophage, applied intravenously and locally to the leg.

TYPHOID FEVER AND PARATYPHOIDS*

The therapy by bacteriophage of typhoid and paratyphoid fevers has been the object of many studies and reports since Beckerich and Hauduroy published their first observations. Some have obtained marked success while others have failed. As for typhoid fever the therapy is made more difficult by the fact that it entails special laboratory tests to find the desired polyvalent bacteriophage, obtained by mixing bacteriophages of a large number of variety of races. Much has been accomplished in Italy along these lines. A laboratory in Rome prepares a polyvalent bacteriophage by isolating a variety of races of phage from specimens of stools from patients in the locality of an epidemic. This bacteriophage is then sent to the various localities where there is an epidemic of typhoid fever with instructions that it be given both intravenously and orally. This method, according to the last publications of Alessandrini,* has given excellent results, and the number of failures is decreasing. If the therapy does not meet with success, the laboratory at Rome sends a bacteriologist who isolates from specimens of stools of convalescent patients a new race of bacteriophage, which is added to the stock bacteriophage.

Typhoid fever is mostly a septicemia; therefore, the administration of bacteriophage is indicated not only 2 to 5 c.c. every six hours *per os* but also intravenously, in the same way as in staphylococcic septicemia, i.e., in doses of 10 to 20 c.c. diluted to 500 c.c. in isotonic saline solution, and injected slowly within a period of at least thirty minutes.

Further investigation into the use of intravenous bacteriophage in treating typhoid carriers will be of great interest.

SUMMARY

A case is reported of a typhoid fever carrier with typhoid periostitis and bone abscess having positive cultures from the abscess, the bladder urine, the blood and the bile, which was completely cleared by bacteriophage administered locally and intravenously.

* Translated from: The Bacteriophage and Its Therapeutic Applications by F. d'Herelle. In: La Pratique Medicale Illustree, G. Doin & Co., Paris, p. 23.

* Alessandrini and Doria. *Med. Klin.*, 20: 1447, 1924 and *II. Policlinico*, 31: 109, 1924.

SNAPPING THUMB: TENDOVAGINITIS STENOSANS

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SNAPPING thumb, or tendovaginitis stenosans, is caused by a localized enlargement of the tendon, usually the flexor pollicis longus, as it passes only with effort through a partially stenosed tendon sheath; it is characterized clinically by a typical snap or click upon both flexion and extension of the distal phalanx. There is a greater or less degree of pain at times and always considerable annoyance.

In 1933, Compere[1] reviewed the literature and found but 38 cases reported, adding one of his own. It is believed that the present case report tends to verify the general impression of the etiology.

CASE REPORT

A. M., a Frenchman, forty-five years of age, was seen for the first time on January 10, 1935. The past medical history was negative, even childhood diseases could not be recalled. Fifteen years ago the right index finger was fractured in a mine accident. The result was excellent. He has never had anything similar to the present difficulty. Three brothers and two sisters are living and well. His mother died of "tumor of the breast" and the cause of his father's death is unknown. The patient's wife is living and well, as are four children.

The patient is a machinist and at the time was operating a punch press. In the routine movements there was an almost constant flexion and extension of the right thumb. On November 24, 1934, while pushing a tank of oil on a truck, his right hand slipped, forcibly abducting the thumb. This pained moderately and he returned to work after half-an-hour but it increasingly became worse. On January 10, 1935, the doctor advised hot soaks, but with very little benefit. About May 1, a click or snap became noticeable on both flexion and extension of the distal phalanx. An *x*-ray picture revealed nothing abnormal. The click became more pronounced and rather painful, so that it became impossible for the patient to work.

Physical Examination. The patient is a well developed laborer of forty-five years. His temperature, pulse and respiration were normal. The routine blood count, urine analysis and blood Kahn were negative. His pupils react to light and accommodation and patellar reflexes are normal. His teeth have recently been repaired and cleaned. The throat is negative. The chest and abdomen are normal. His extremities are normal with the exception of the right thumb. Upon both flexion and extension, accomplished with both pain and effort, occurred a distinctly audible snap. A tender nodule in the region of the tendon near the metacarpophalangeal joint could be palpated and moved with the tendon, both abruptly.

A diagnosis of local traumatic enlargement of the tendon of the flexor pollicis longus was made and surgical measures urged. The patient was operated upon June 7, 1935, at Springfield Hospital under nitrous oxide-oxygen anesthesia. The incision was made on the outer side of the thumb from the interphalangeal joint to the base of the first metacarpal bone. The medial flap was reflected and the tendon sheath exposed by blunt dissection. Just proximal to and incorporated with the transverse volar ligament the sheath was surprisingly thick and fibrous and seemed capable of causing an obstruction. Upon extension of the distal phalanx of the thumb a firm fusiform swelling in the tendon snapped into view with an audible click. This enlargement was approximately twice the diameter of the tendon and about one cm. in length. After overcoming an initial resistance the nodule, upon flexion, again passed through the constricted portion of the sheath with an identical snap.

The transverse band was divided and the sheath opened longitudinally for about 3 cm. The tendon was split longitudinally and about half the fusiform swelling excised from within, thus forming a normal sized tendon with only a smooth glistening surface presenting to

the sheath. No attempt was made to close the tendon sheath. Hemostasis was obtained, the skin flaps were approximated with subcutaneous catgut and closed with clips. The patient remained in the hospital three days and was discharged without evidence of wound infection.

Early passive motion was employed by the patient for one week. Following this, active motion was encouraged and he returned to his original work nine days after operation.

The patient was last seen October 12, 1935, having worked continuously since June 16, 1935. Function was perfect and there had been no pain for the past month. There was, however, a small area of anesthesia on the medial aspect of the thumb, supposedly the result of division of sensory nerves at the time of operation.

COMMENT

In 1895, de Quervain[2] first described the syndrome associated with stenosis of tendon sheaths with or without an enlargement of the tendon although he limited the occurrence to the sheath of the abductor longus and extensor brevis pollicis tendons in the region of the radial styloid process. The last comprehensive review of the general subject is that of Finkelstein,[3] in 1930, who recognized its appearance in other tendons. The article of Compere limits itself to lesions of similar type occurring in the pollicis longus tendon of the thumb. He apparently found 38 cases, 2 of which were bilateral, and added his own case, also bilateral.

It seems to be a general impression that continuous chronic trauma is the most important single factor in the etiology of this condition. Most of the cases reported stress the occupation; among these are found pianists, typists, bookkeepers, maids, factory workers, tailors and clerks, all giving a positive history of prolonged, frequent and vigorous movements of the tendons in question.

Likewise with the present case, his work required continuous movement of the thumb and although the difficulty in question began with an undoubted traumatic injury to the sheath or tendon or both, it is significant that the snapping began five months later and in all probability would not have occurred in the absence of the continuous daily trauma.

The stenosis seems to be of primary importance since many of the tendons in reported cases showed no thickening. Finkelstein's experiments have demonstrated that with an intact skin it is possible to cause a stenosing tendovaginitis in rabbits by thermal, chemical or mechanical traumatization without visible pathology in the tendon. Changes occur in the tendon only when injury is inflicted directly to the tendon. This would indicate that the nodules reported were caused by direct injury to the tendon. However, the occurrence of symptoms of a nodule five months after the original injury in our case would strongly suggest that the nodule was secondary to the sheath injury and represented an irritative localized hyperplasia of the tendon following only after the sheath presented a rough edematous inflammatory surface with consequent friction throughout a chronic prolonged course.

CONCLUSIONS

1. A case of snapping thumb is reported, caused by a stenosing tendovaginitis of the sheath, and with nodule formation in the tendon of the flexor pollicis longus.

2. Conservative treatment was unsuccessful. Surgical division of the sheath and excision of the nodule resulted in cure.

3. Judging by this case, the trauma to the sheath is the primary injury; it seems unlikely that such a condition would result, however, in the absence of repeated, prolonged, vigorous, occupational trauma.

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ARTERIOVENOUS ANEURYSM OF HAND*

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THE establishment of fistulous communications between arteries and veins, without the intervention of the normal capillary bed, leads to the development of such clinical conditions as simple angiomata, cirsoid aneurysms and arteriovenous aneurysms. Although differing both grossly and histologically in appearance, depending upon the size and the character of the blood vessels involved, the pathogenesis is the same, namely abnormal communication between arteries and veins.

Such communications may be either congenital or acquired, and may occur anywhere in the body. Amongst the common causes of the acquired arteriovenous communications are bullet wounds, blows and injuries. The congenital communications are most often due to intrauterine trauma or pressure. Thus the congenital cirsoid aneurysms are theoretically explained as being caused by the pressure of the bony pelvis on the fetal head or as the result of the application of forceps. Some observers, however, believe, that congenital arteriovenous aneurysms are due to the persistence of abnormal fetal blood vessels between arteries and veins.

The symptoms and physical signs of arteriovenous fistulas depend on the location of the lesion. When there is a communication between larger vessels such as the femoral artery and the vein in the groin, or between the carotid vessels of the neck, a large tumor mass is present with distinct pulsation, thrill on auscultation and bruit. When the lesion involves an extremity, circulatory disturbances such as edema of the leg, redness, cyanosis, hypertrophy of subcutaneous tissue and atrophy of the muscles and bones are present. Abnormal communication of the vessels of the neck may lead to exophthalmus of the eye. Systematically, large arteriovenous fistulas cause cardiac enlargement, increased pulse rate, low diastolic pressure and high pulse pressure. The diagnosis may be aided by arteriograph and by determining the oxygen content of the blood in the veins leading from the tumor mass.

The following case presented itself at the Surgical Clinic of the Hospital for Joint Diseases:

CASE REPORT

P. S., a truck driver, aged twenty-seven years, was first seen on April 11, 1935, because of an uncontrollable hemorrhage from the index finger of the right hand. His present illness began five years ago when he struck his right thumb with a small nail. The finger became infected and was treated at another hospital for two years with wet dressings. It continued suppurating, gradually became worse and then gangrenous. The terminal phalanx of the thumb was amputated. The pathological report was chronic inflammation with ulceration. The condition was not recognized at the time.

Two years ago the patient noticed that the rest of the thumb and part of the thenar eminence was swelling, and that the nail bed of the right index finger was discolored. The distal half of the index finger became atrophic and distorted, while the proximal half became thicker. He noticed a distinct pulsation over the thumb, thenar eminence, the proximal half of the index finger and the adjacent palm. The fingers became excruciatingly painful at times, ulcerations appeared over the index finger and the slightest trauma to the finger led to severe hemorrhage.

The general physical examination was negative, the distal phalanx of the thumb of the right hand is missing; the balance of the finger

* From the Surgical Service of the Hospital for Joint Diseases, New York City.

tapers to a point and the soft tissues pulsate and fluctuate.

X-ray examination reveals necrosis of the terminal phalanx of the index finger, but the soft tissues appear to be intact. There is distinct soft tissue swelling of the thumb, with almost complete necrosis of the distal phalanx. The phalanges of the first and second fingers are osteoporotic and show medullary expansion and distinct cortical thinning. These changes can represent pressure necrosis produced by a blood vessel tumor of the part.

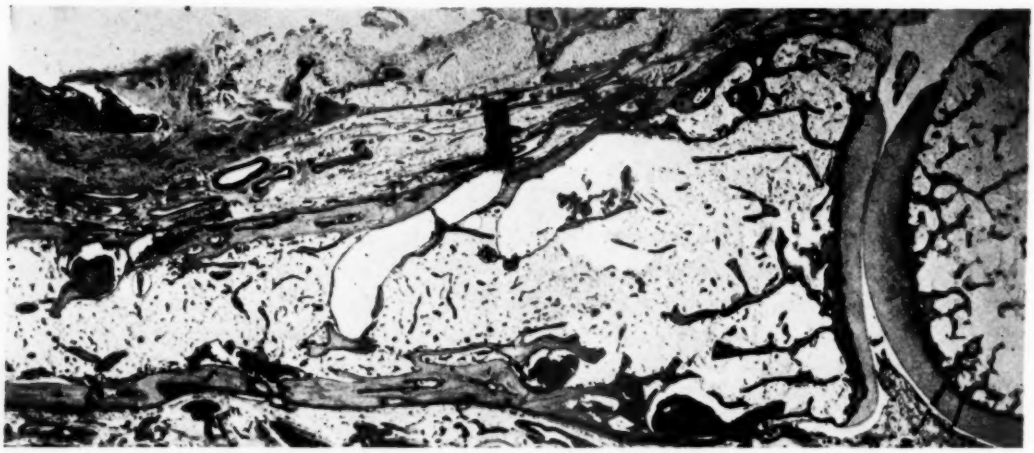

FIG. 1. Section through bone showing thin walled angiomatous vessels.

FIG. 2. Section through soft tissue showing character of the blood vessels.

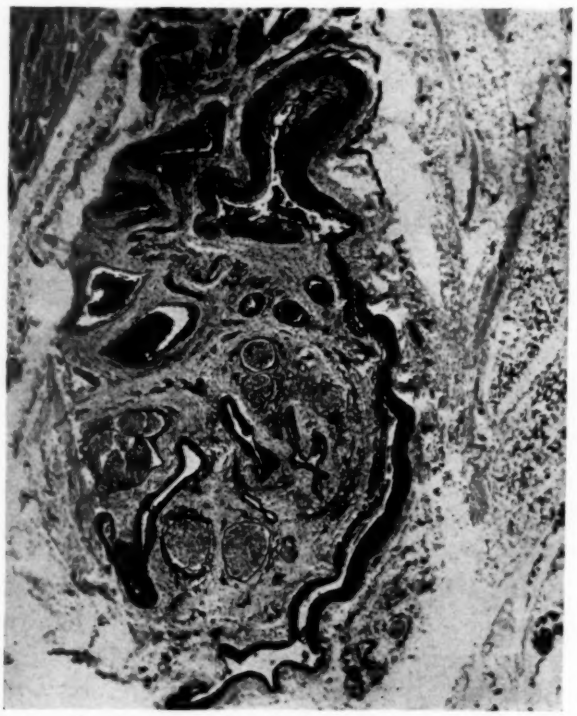

FIG. 3. Section through soft tissue showing anastomosing channels.

Arteriography was attempted but without success.

The impression obtained is either an angioma or anteriovenous aneurysm.

Operation consisted of an excision of the vascular tumor of the palm of the hand with

disarticulation of the index finger at the metacarpophalangeal joint and the thumb at the metacarpophalangeal joint. Sufficient skin was obtained to cover the exposed areas except a small region about 1 × 2 inches which eventually closed.

Pathological Examination. The gross specimen consists of two digits. The skin and the subcutaneous tissues are discolored obviously the result of the presence of numerous large anastomosing and engorged vascular channels beneath the epidermis. On section of the phalanges it was observed that the distal phalanx of the thumb and the middle phalanx of the index finger were permeated by similar large vascular channels. These bones were resorbed to a very considerable degree and appeared dull white, suggesting the existence of necrosis.

Microscopic. The vascular changes are very widespread, involving particularly the soft tissues, but also the marrow spaces. There is continuity of the channels through canals which perforate the cortex. The vessels vary considerably in type, especially in the subcutaneous tissue. In these areas where inflammation is absent, the vascular channels are everywhere rather large and thick walled. They are irregularly folded. The large majority of the thick walled channels have the histologic constitution of vessels which are neither certainly arteries nor veins. Many of these channels are fairly thick at one point and thin out very abruptly at another. Most of the vein like structures show definite evidences of hypertrophy of their intimal and muscular coats. In many of the sections communications between artery-like vein-like channels are in evidence. Another striking feature observed in many of the sections is the plica-like foldings of the arterial and venous vessels. Where infection is present in the subcutaneous tissues, many channels are thin walled, and much of the tissue assumes the character of granulation. In places the marrow spaces contain large, thin walled angiomatous vessels; such structures are even observed in some portions of the soft tissue. The bone shows thinning and increased vascularization of the cortices. It furthermore presents areas of necrosis with regeneration through creeping replacement.

Diagnosis. Arteriovenous communications in fingers with infection and changes in the bone.

SUMMARY

A case of arteriovenous aneurysm of the hand is presented. Early recognition and adequate surgical removal is essential for the cure of this condition.

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NEW INSTRUMENTS

CONTINUOUS WET DRESSING

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THE wet dressing is an important feature in the treatment of suppurating wounds, as it permits better drainage of pus, restricts inflammation to a local process and stimulates to early healing. Clinically, the patient enjoys a sense of comfort and relief from pain which is directly attributable to the moist heat.

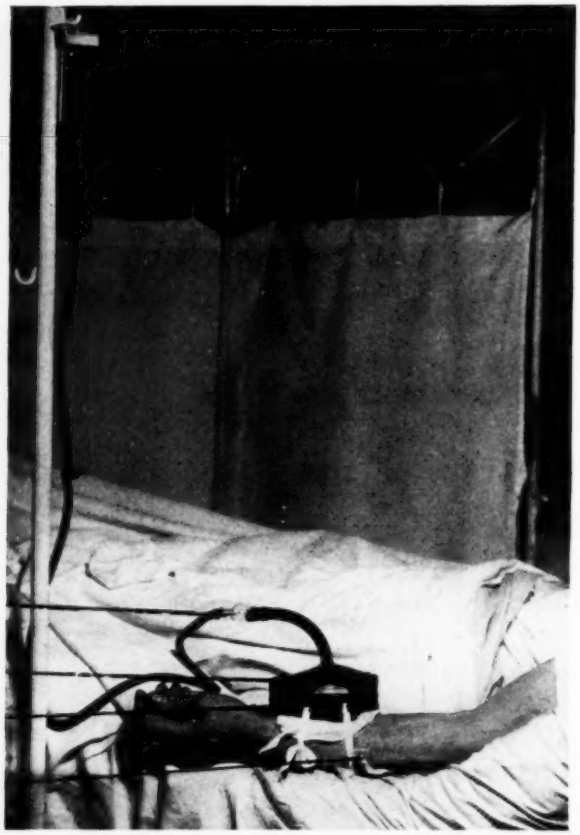

FIG. 1. *a*. Murphy drip glass cannula. *b*. Rubber sponge. *c*. Shower head. *d*. Tape.

The purpose of this report is not to discuss the merits of the hypertonic, antiseptic or hypotonic wet dressings. This subject is still in the investigatory phase though there is general accord on the value of wet dressings.

In hospital practice in order to keep certain wounds wet, the usual custom is to instruct the nurse to repeat the wetting every two or three hours. On large surgical services with limited facilities it is often very difficult to care satisfactorily for these cases, therefore we have created a device for maintaining a continuously wet application to such wounds. We believe it can be used comfortably and satisfactorily for any suppurating wound in any part of the body without requiring more than a reasonable part of the nurse's or attendant's time.

This apparatus is simple and easily assembled. It consists of a 500 c.c. flask, ordinarily used for hypodermoclysis, to which is attached a length of rubber tubing about two or three feet long. At one end of the tube a Murphy drip glass cannula is inserted so that the amount of solution delivered to the wound can be measured in drops and regulated by the metal thumb screw attached on the tubing. The free end of the glass cannula is inserted into a shorter rubber tube about six to eight inches long. The additional accessories of the apparatus consist of a rubber sponge and a small size shower head (Fig. 1*b* and *c*).

Through the side of the rubber sponge a space is cut equivalent to the circumference

and thickness of the shower head which is inserted with its top protruding through the surface of the sponge. Tape or narrow strips of bandage are run along the sides of the shower head. By tying the tapes the apparatus can be fixed to the region of treatment.

The rubber sponge is easily sterilized by boiling; the rest of the apparatus can be autoclaved. The solution in the bottle can be kept warm by means of a heat lamp about the flask. Whenever necessary the flask can be refilled. The sponge can be placed directly in contact with the wound or a single layer of gauze may be interposed. Bandage is then applied so that the sponge is completely enclosed by the dressing.

We have used this apparatus for all kinds of wounds, both clean and infected. It has been used extensively for infections of the extremities and in the first twenty-four hours after an emergency surgical repair of traumatic wounds where infection was a possible sequel. It has worked efficiently in suppurating postoperative abdominal wounds. The rubber sponge, we believe, is as efficient as the sea sponge recommended by Davis for surgical wounds. On inspection of wounds treated in this manner, the skin is soft, there is no crusting, drainage is replete and healthy granulations appear early. This device will provide a better postoperative course for properly selected cases.

PRESSURE BAG IN SKIN GRAFTING*

FREDERIC TAYLOR, M.D.

INDIANAPOLIS

A GREAT many varied types of dressing are in popular use for covering the ordinary split-thickness skin graft and dry heat with no dressing at all is frequently employed. However, for the most part, a gauze dressing is used. Around the immediate sterile dressing is usually placed some form of pressure bandage. These are said to be applied "firmly," "tightly," "snugly," etc. depending upon the descriptive tendency of the clinician.

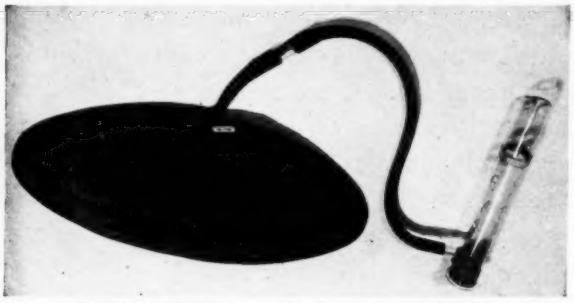

FIG. 1. Rubber bladder and tube connecting it to glass stand pipe 15 cm. in height. The stand pipe is open at the top to allow filling with water. This also allows for an overflow should pressure in the bandage exceed 15 cm. of water, due to movement or muscular contraction.

Because of the ease with which split-thickness grafts take, all the various forms of dressing seem equally effective and successful. However, so long as pressure bandages continue to be used, it seems absurd to apply them without knowing just how much pressure is being exerted upon the grafts. There is no reason to believe that a "firm" pressure bandage to one may even approximate another's conception of the same degree of "firmness." Also, as indicated by Smith,[1] a firm bandage today will certainly not be firm tomorrow or the next day unless the resulting slack is taken up by some form of elastic dressing.

As suggested, in most grafts it is of little moment what pressures are used. However, in some grafts such as those involving the axilla, neck, thorax or abdomen, it would seem highly desirable to use a constant pressure dressing. Since there is continual movement of these regions, the dressing should be able to compensate for such movements.

FIG. 2. Apparatus in use on a graft of the forearm.

The simple apparatus described is the result of an attempt to obtain a constant and known pressure upon such skin grafts. It has proved of definite aid and value in these cases.

APPARATUS

The apparatus consists of an ordinary football bladder attached by a rubber tube to the base of a glass stand pipe (Fig. 1). It will be noted that the upper end of the stand pipe is open. After first applying the usual sterile gauze dressing to the grafted area the bladder is incorporated loosely in the outer bandage, as shown in Figure 2. The glass stand pipe is then fastened in a convenient upright position by means of adhesive strips. Water is poured in the open upper end until it rises to the desired "head" above the graft surface.

The pressures used have been between 10 and 15 cm. of water. Since the glass

* From the Surgical Service of the Indianapolis City Hospital.

stand pipe is but 15 cm. in height and is open at the upper end, the pressure can never exceed 15 cm. of water. If movement on the part of the patient causes the water in the rubber bladder to exceed 15 cm. of water, it merely overflows from the upper end of the stand pipe. It was found that after the bandage had been in place for a few hours it became considerably looser. Therefore during the first day or two additions of water were necessary to maintain the pressure indicated.

Just what might be the optimum pressure to apply to skin grafts was not determined. Since the graft must become vascularized, it would seem desirable to apply a pressure slightly less than the venous capillary pressure. This has been fairly well established as being between 15 and 20 cm. of water.[2] In the present study the former figure was used as the maximum.

On full thickness grafts Smith[3] advocated a pressure of approximately 40 cm. of water. This was obtained by incorporating a rubber bag in the dressing and inflating it to the above pressure. The writer has had no experience with these higher pressures. However, they would seem to be excessive since new capillaries must actually grow into the grafted skin.

It is hoped that further inquiry into the matter of the most desirable pressure, and the use of the constant pressure type of dressing in full thickness grafts may be the subject of a future communication.

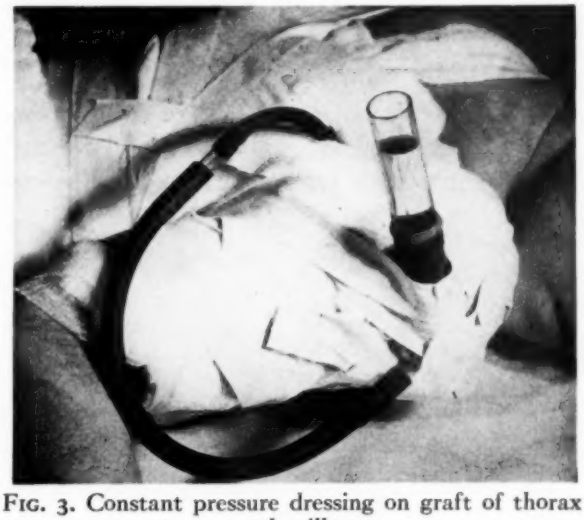

Fig. 3. Constant pressure dressing on graft of thorax and axilla.

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USEFUL CLAMP FOR THYROIDECTOMY

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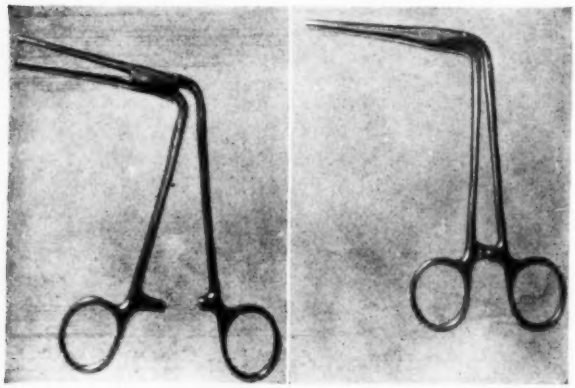
BROOKLYN, NEW YORK

TRANSECTION of the prethyroid muscles is frequently employed in the operation of thyroidectomy, and is of especial value in total ablation of the thyroid gland for congestive heart disease where a complete exposure and scrupulous dissection of the thyroid structure is imperative. A useful and simple clamp is devised and employed to facilitate thyroidectomy.



A B

FIG. 1. Illustration of clamp.

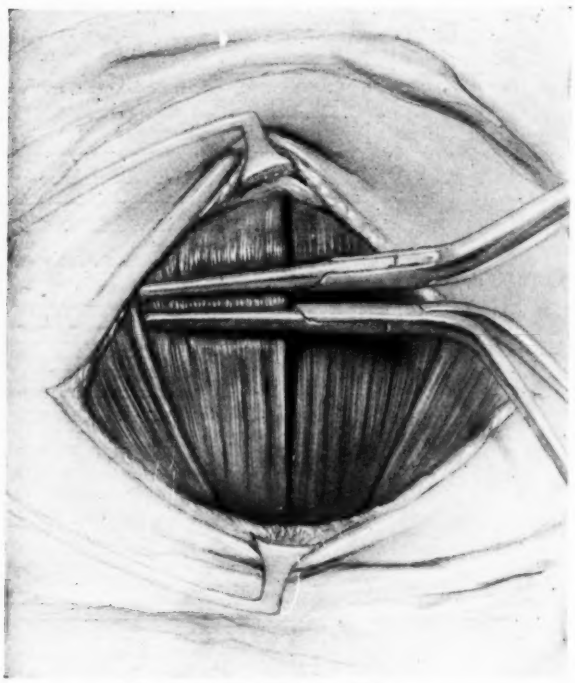


FIG. 2. Application of clamps.

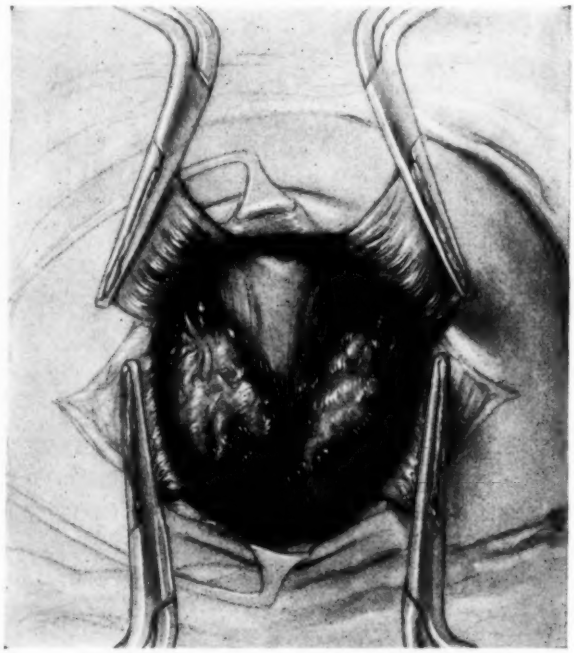


FIG. 3. Ribbon muscles transected and clamps out of operative field.

The instrument is a right angled clamp with transverse serrations and a mouse-tooth tip as illustrated and can be made in various sizes. Two such clamps are applied to the ribbon muscles near their upper attachments and the prethyroid muscles transected; retraction upward and downward of the latter is then easily obtained by holding the handle of the clamp up or down. Often it is unnecessary to hold these clamps for they remain in the desired position because of their own weight. No extra clamps need be applied to the severed ends of the muscles employed for transection; and a complete exposure of the upper and lower poles of the thyroid gland is obtained, thus permitting of complete mobilization of the gland.

[From Fernelius' Universa Medicina, Geneva, 1679.]

BOOKSHELF BROWSING

NOTES ON EVOLUTION OF PROSTATIC RESECTION*

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INDIANAPOLIS

IT has been suggested that it would be desirable to present some of the efforts that the writer made almost a half century ago, and subsequently, in trying to determine the value of the use of the cautery under visual observation for the reduction of vesical neck obstruction, and that this should include subsequent efforts to improve the technique in the development of instruments for that purpose. While this may seem to have historical interest as its chief value it has a somewhat direct relation to present methods. Therefore an endeavor will be made to present briefly the various steps as they developed. Related papers have been presented but a connected story of the writer's procedures has not heretofore been given. If references are made to matters that seem to be ancient history, Dr. Lowsley is asked to share the responsibility, as in his invitation he gave unrestricted liberty in the selection of a topic.

Apology for doing so is also due to the fact that sufficient recent interest has been expressed in this subject to justify a review of the writer's efforts to use the cautery in the manner herein described. In giving reference to papers published many years ago, the writer is only presenting the data for those who care to verify the history of visual observation in the application of the cautery.

The use of the Bottini method was not regarded as a rational or satisfactory procedure, as accuracy in placing the cautery was quite impossible. The application through a median perineal opening without visual observation, known as Chetwood's operation, had definite advantages over the Bottini method in that it allowed the introduction of the finger for diagnosis and definite location of the obstruction. However, it also was an operation done without visual observation.

The History of Urology in America (Vol. 2, page 151) indicates that the writer was an early advocate of Chetwood's method. This is erroneous, as he never employed that method at any time. He did devise a substitute metal sleeve for use over the cautery shaft of his own instrument, for use in cases where hemorrhage or other causes might make clear vision difficult or impossible. However, he never found a case in which visability was not easily obtained and hence never used the

* Read by invitation before the Urological Section of the New York Academy of Medicine on the occasion of the fifteenth anniversary of the Department of Urology, James Buchanan Brady Foundation of the New York Hospital, January 15, 1936.

special sleeve he devised for supposedly exceptional cases.

At the Toronto meeting of the American Urological Association in 1932 an interesting symposium was given on the present method of resection under visual observation. The writer was invited to open the discussion and suggested that the various references in some of the papers that had been read and in the literature of the past few years indicated that visual observation of the prostate while using the cautery was of rather recent development. Attention was called to the fact that while the current now used was of comparatively recent origin, the application of the cautery under visual observation was by no means new, and that the use of the galvanocautery under visual observation was applied in 1890 and presented before the American Association of Genito-Urinary Surgeons at Washington City in September, 1891, some forty-two years prior to the Toronto meeting. A subsequent paper was read before the American Association of Genito-Urinary Surgeons at Atlantic City April 29, 1902, entitled, "The Use of the Cautery on the Prostate through a Perineal Opening —A New Method with Presentation of Instruments and Report of Cases."* Reference is also made to a paper entitled "Operative Treatment of Prostatic Hypertrophy" read before the New York Branch of the American Urological Association, April 7, 1906.

Since the meeting of the American Urological Association in 1932, many requests have been received for information as to the writer's first publications and the technique first employed and its subsequent modification, to which requests an endeavor will be made to reply briefly.

In his earlier experience, and in all subsequent operations, with the exceptions noted, a view of the prostate was obtained through a median perineal opening. In the first case in 1890 a median perineal opening was followed by the removal of a nodular intraurethral hypertrophy with the cautery, and subsequently the removal of intravesical obstruction by suprapubic prostatectomy by the then current McGill method. The latter was done May 14, 1890.

In this case a perineal opening for drainage was first made for relief of acute retention because it was impossible to pass a catheter. The same technique, excepting the addition of a suprapubic operation, was applied in more than 150 selected cases during the following twelve years. In almost all of these the cautery alone was used through a perineal opening. In some it was auxiliary to median perineal prostatectomy.

The use of the cautery in these first efforts made in that direction, was suggested by a similar use, under visual observation, for the reduction of nasal obstruction by using a head mirror and reflected light. Observation of the operative area was made through a small rectal speculum introduced through a perineal opening. An ordinary rectal tube, measuring ¾ inch in diameter, being introduced, a longitudinal incision was made in the lateral lobes, and obstructing growths about the vesical orifice were caught in a small, straight tenaculum and drawn into the distal end of the tube and excised or divided with the cautery knife. In other cases the knife without the tenaculum was used. The knife which is here shown is the original one which was used in 1890 in the first case mentioned, where a combined perineal and suprapubic operation was employed.

Acknowledgment is also made to the rhinologists for the thought of making, in 1893, the specially devised snare here shown, and used in cases where it seemed desirable to draw projecting growths into the distal end of a rectal tube passed through a median perineal incision. The snare was passed over a tenaculum and around the growth and the current applied as the snare was tightened, and in this way definite cautery excision was possible in some cases. At no time was this method of using the cautery regarded as applicable to

* *Jour. Cutan. and Genito-Urin. Dis.*, June, 1902.

all cases of prostatic hypertrophy. The limitations of the cautery knife and snare were clearly recognized and their value regarded as especially applicable to growths about the vesical orifice and to some extent, in the reduction of larger growths impinging upon the calibre of the urethra.

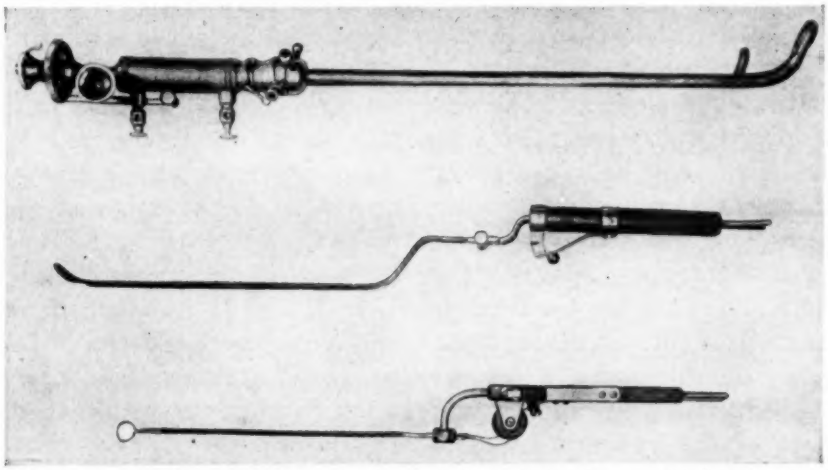

Fig. 1. Upper. Author's cautery snare. Middle. Author's cautery knife. Lower. Author's operating cystoscope.

After using the cautery knife and snare through a rectal speculum with reflected light, from 1890 until 1902, in the latter year the writer devised a special cautery instrument, here shown, combining a diagnostic tube with a movable cautery and a light at the distal end of the tube and with an observation window at the proximal end. This instrument was used through a perineal opening with air dilatation of the bladder secured through an auxiliary tube. Visual observation was thus much improved over reflected light by having a lamp immediately opposite the movable cautery knife. This instrument was first presented, with a description of the technique of its use, in a paper read before the American Association of Genito-Urinary Surgeons at Atlantic City, April 29, 1902.* In the same paper was described the use of the snare through a perineal opening, and also the transurethral application of the cautery through a Koch's air dilating cystoscope.

Transurethral and transperineal use of the cautery with the Koch's air dilating cystoscope was used only in a few cases as the field of observation in the application of the cautery through this instrument was limited and cauterization rather superficial.

In 1902 the writer also devised an operating cystoscope which was shown at the meeting of the American Association of Genito-Urinary Surgeons at Atlantic City, but not described in the paper reporting the new perineal tube as it was received only shortly before the meeting and had not been used. With the perineal instrument, as with the operating cystoscope, the depth and length of the incision was easily regulated by turning a device at the outer end of the instrument. This operating cystoscope was not well made and owing to defective mechanism and the skepticism

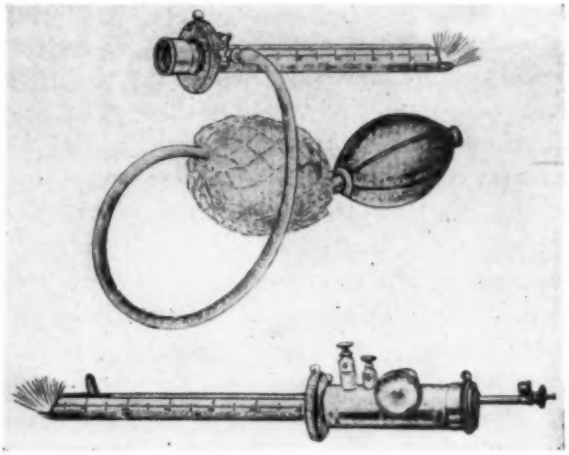

Fig. 2. Author's combined perineal diagnostic tube and cautery.

* *Jour. Cutan. and Genito-Urinary Dis.*, June, 1902.

of the writer as to the wisdom of making a cautery incision without subsequent and adequate drainage, the use of the instrument was regarded as unsatisfactory. It did not actually involve observation of the operative area at the time the cautery was applied. Air dilation was used and observation of the proposed operative area was made and the instrument held firmly in the hands of the operator while an assistant removed the telescope and introduced the shaft bearing the cautery which was then applied. Several years later Goldsmith developed an instrument involving the identical features of the writer's instrument, with the added advantage of the simultaneous use of the cautery and the telescope and irrigation.

The perineal instrument, however, was used in selected cases for ten or twelve years following its development in 1902 in some 240 operations. The diagnostic tube has a circumference of 42 mm.; an oblique distal end which carries a small incandescent light and on the proximal end a window is attached to allow inspection and location of the operative area while the bladder is dilated with air. After inspection of the bladder and prostatic urethra the cautery was inserted and the cautery knife exposed by the device at the proximal end of the tube. The movable cautery knife was then drawn into the obstructing tissue. This adjustment permitted the incision to be of any desired depth or length, while controlled air dilation and distal illumination made observation quite satisfactory. Bleeding occasionally interfered with visability but was usually controlled easily by leaving the diagnostic tube in position and removing the cautery and irrigating the area, but at no time was it sufficient to prevent continuing the operation. Restoration of bladder function almost invariably followed, but where there was subsequent recurrence, resort was had to prostatectomy. The use of the cautery in the method described was the only procedure used in the type of cases referred to, except in occasional cases where a perineal prostatectomy had already been done and subsequent inspection revealed small tabs for the removal of which the cautery was supplemented. Other cases were relegated to perineal or suprapubic prostatectomy.

The operation was principally one of cautery incision, excepting in cases where the snare, herein described, was used. It was, however, an incomplete surgical operation and after use in selected cases for more than twenty years, it was abandoned for suprapubic or perineal prostatectomy.

In his early and subsequent experience the writer believed that when the cautery was used at all it should be done with the operative area under the direct observation of the operator, and that prior to its application, opportunity should also be given for digital examination of the prostatic urethra, the vesical orifice and the bladder.

As stated, the method developed was applied to selected cases, especially to small growths around the vesical orifice, including transverse bars and contractures of the orifice, and also to small growths impinging on the prostatic urethra. Its use in any case was not definitely decided until a perineal opening had been made for inspection and the finger inserted into the bladder and prostatic urethra for confirmatory diagnosis. This diagnostic procedure was followed in all cases, except in a few where the air-dilating cystoscope was used. If much infection was present, the bladder was drained through the perineal opening until conditions justified the use of the cautery. The method was not regarded as a major operation, as its limits were defined clearly as a somewhat minor procedure. In this limited class of cases the cauterization alone reduced the obstruction, and bladder function was uniformly restored. Except in cases where there were complications the mortality was practically nil.

The diagnostic facilities available forty-five years ago are still inadequate to reveal accurately the mechanical relations involved. In many cases there is considerable elongation of the prostatic urethra with

increased curvature. The shaft of a cystoscope is straight with a terminal curvature to facilitate introduction. When introduced, an elongated and acutely curved canal is straightened by the instrument and the growth depressed posteriorly and the true mechanical relations, especially of intravesical growths, cannot be determined as accurately as compared with their position before the instrument is introduced. This fact was evidenced in the writer's first use of a cystoscope in 1890, where the view obtained was compared with subsequent inspection through a suprapubic opening.

It is not in the scope of this paper to discuss the present method of resection but it may be apropos, in considering the writer's abandoned procedure, to refer to the present day resection which is also done under visual observation and is a far more complete procedure than that which is herein described, and which seems to make possible the restoration of the calibre of the prostatic urethra and the lowering of an elevated vesical orifice to its former position.

The decrease in the death rate is gratifying as indicated in recently published statistics by various writers. There are, however, other considerations which also are important. They include the question of end results which it will take more time to determine accurately.

As already indicated the writer has always been impressed with the mechanical problem of accuracy or otherwise in determining the real position of prostatic tissue as seen through the cystoscope. Certainly it seems a problem to keep in mind when doing resections. It is quite possible to enucleate a very large amount of prostatic tissue. The problem, however, is how little or how much, as recurrence of symptoms suggests the question of whether enough tissue has been removed, or whether there is a subsequent increase of the growth.

Among other difficulties attending resection may be mentioned delayed hemorrhage. Quite recently in the urological clinic with which the writer is associated, a very severe hemorrhage occurred two weeks after resection. The difficulty in removing blood clots was so great that a suprapubic opening was at once made and the prostate enucleated.

There is another factor which is of sufficient importance to require careful consideration. Some two years ago the writer asked the pathologist of a large urological clinic as to the most frequent point of initial location of malignancy. He said it often occurred posteriorly in cases of apparently benign growths. He made sections of several such growths which had been enucleated suprapubically and which, upon examination, showed beginning malignancy located rather low and nearer the rectal than the urethral side of the growth. The latter question seriously involves careful preoperative diagnosis. One would not want to resect an apparently benign growth and later find that an initial area of malignancy had been left.

The foregoing comments are not to be regarded as unduly critical of resection but represent points for careful consideration. Resection has a permanent place in vesical neck surgery which is increasingly evident, and it is obvious that its scope and its limitations are being more clearly defined and better applied.

The Brady Foundation is greatly contributing to the solution of such problems. It would require somewhat intimate knowledge of the amount and character of its work to appreciate the accomplishments of the Foundation on this, its fifteenth anniversary. Its establishment, with ample endowment, as the Urological Department of the New York Hospital, gives assurance of its permanence. The work undertaken requires, and continues to call for a rare combination of executive and professional understanding and cooperation. Constant increase in the amount and scope of the work, as shown by the record, and its fine cooperative spirit gives evidence that the Foundation is fortunate in the personnel of the director and his professional associates.

It is only possible for the writer to call attention very briefly to a few of the many phases of scientific endeavor which are outstanding. One is the running of parallel cases in various phases of the work of the Foundation. In the matter of prostatic surgery, for example, there is developing here a comparative record of suprapubic prostatectomy, by the one and the two stage methods, and also by perineal prostatectomy, and in the third group transurethral resection. Emphasis is made on accuracy in preoperative diagnosis. Kirwin of the Brady Foundation staff has outlined the most satisfactory method of preoperative diagnosis, with reference to the type of cases suitable for resection* which the writer has had the privilege of seeing.

A few years ago Lowsley and Butterfield emphasized the growing need for study of urological conditions in children. Butterfield's cystoscope for children made possible the catheterization of both ureters in very young children at a single sitting and his catheter deflector contributes much to the use of so small an instrument. His was the original observation that thickening and infiltration in the cystic masses about the vesical neck are the cause of intractable enuresis and are cases for fulguration. Other members of the professional staff of the Brady Foundation, by their individual and cooperative work, are continually enriching the literature of urology and contributing to the relief of human suffering.

To summarize, so far as the writer is aware, a transurethral application of the cautery under visual observation had not been reported previous to 1891. The transurethral use of the Koch instrument and also its use through a perineal opening is further referred to in a paper read by invitation before the St. Louis Medical Society.*

The last decade has witnessed the development and wide application of prostatic resection under visual observation. Although the current now used is different, the principle of visual observation in the application of the cautery is not new as it was applied in 1890. A review is given of its original application through a perineal opening. This method was suggested by a somewhat similar application in nasal growths and the technique consisted in passing a small rectal tube through a perineal opening and using reflected light from a head mirror, a galvanocautery knife was applied under visual observation. In 1893 a snare was used and in 1902 a specially devised perineal diagnostic tube and cautery with air dilation of the bladder were substituted for the previous method.

In 1902 the author also reported the use of the transurethral application of the cautery through a Koch's air dilating cystoscope. The use of the cautery under visual observations was continued for more than twenty years but was regarded as being of limited application, especially applicable to small growths around the vesical orifice. The transurethral use of the cautery and of the snare and the perineal use of a cautery knife under visual observation obviously is of earlier date than has heretofore been credited.

A brief review of the earliest use of the cautery under visual observation is presented. After more than twenty years use the writer discarded the use of the cautery in this manner because of its limitations and has since relied chiefly on suprapubic or perineal prostatectomy. The subject is presented for whatever historical value it may have.

* *Am. Jour. Surg.* (Jan.) 1933.

* Published in the *St. Louis Medical Review* (June 7) 1902.

BOOK REVIEWS

RADIOLOGICAL ATLAS OF CHRONIC RHEUMATIC ARTHRITIS (THE HAND). By S. Gilbert Scott, M.R.C.E., L.R.C.E., D.M.R. and E. CAMB. Honorary Radiologist to the British Red Cross Clinic for Rheumatic Diseases, Regents Park; Honorary Radiologist to the Charterhouse Rheumatism Clinic; Consulting Radiologist to the London Hospital. Oxford University Press. London. Humphrey Milford, 1935. Seventy-seven pages. Price $10.00.

This book is really a radiological atlas of the hand as an index to the various groups of chronic rheumatic arthritis. It is obvious that the radiological examination may play an important part in the diagnosis and classification of chronic rheumatic arthritis where joint changes have occurred, but to the present moment about the only use made of the *x*-rays in this condition is to find out the state of the joints.

The classification of chronic rheumatic arthritis based on the clinical picture alone is extremely difficult and unreliable. Radiology, on the other hand, may supply a direct means of diagnosis of considerably greater value than indirect evidence.

The author describes in detail the characteristic changes met in the four groups of rheumatic arthritis: (*A*) rheumatoid arthritis or atrophic arthritis, in which decalcification of the skeleton is peculiar; (*B*) osteoarthritis, in which the outstanding feature is the loss of cartilage with the formation of osteophytes; (*C*) chronic infective arthritis, in which is noted loss of cartilage with early sclerosis of those bones entering into the formation of the joint, usually of a single finger; (*D*) gouty arthritis, in which there are characteristic punched out areas seen on the edge of the articular surfaces, indicating the presence of gouty deposits. It is, of course, possible to see mixed types in the same patient.

The illustrations are very satisfactory and constitute an eloquent support of the author's thesis that even though the clinical and the radiological classification may not agree at present, eventually it will be found that the radiographic film supplies not only the more accurate means of diagnosis in chronic rheumatic arthritis, but also a means of recognizing the very early stages of the disease, a most important factor when it comes to the question of treatment.

A TEXTBOOK OF ROENTGENOLOGY, THE ROENTGEN RAY IN DIAGNOSIS AND TREATMENT. By Bede J. Michael Harrison M.B., CH.M., D.M.R.E. (Cantab.), F.A.C.R., Director of Department of Roentgenology, Vancouver General Hospital, Roentgenologist to Vancover Public Health Institute for Diseases of the Chest. Baltimore. William Wood & Company, 1936. A book of 826 pages, 238 figures and 7 tables. Price: $10.00.

The first three chapters deal with physics, biological considerations and technique. The remainder of the book then takes up the human body by systems, giving a discussion of both the diagnostic and therapeutic phases of roentgenology in relation to each. There is, therefore, no definite division of the book into diagnostic and therapeutic sections. The author's arrangement gives under each heading a summary of the information relating both to diagnostic and therapeutic use of the *x*-rays. The illustrations are rather satisfactory from the mechanical standpoint and have been so well chosen that most of the important points are nicely illustrated. The book is large enough for a fairly satisfactory discussion of the various topics and it really serves well its purpose of a single volume textbook on the subject of roentgenology.

The author has particularly referred to the fact that so far it does not appear to have been accepted as a basic fact in medical practice that consultation between the roentgenologist and the clinician should take place before any roentgenological examination other than the very simplest is undertaken. The examination and interpretation of roentgenograms are directly correlated with the technique of their production. It may be very difficult to recognize the roentgenograms satisfactorily unless one is capable of analyzing the technique which was employed in producing it. While the roentgenogram is a picture, in a sense, it should not be looked upon as a picture puzzle, but rather as

an illustration in the production of which the roentgenologist is intimately concerned. The clinician supplies the theme, the roentgenologist the technique; and both together should decide on the evaluation of the completed work. The utmost information can be obtained from roentgen study only when the utmost information regarding the suspected pathological condition is considered in planning the examination. This excellent text deserves wide circulation and close study.

EMERGENCY SURGERY. By Hamilton Bailey, F.R.C.S. (Eng.). Second Edition. With 812 Illustrations of which a large number are in Color. Baltimore, William Wood and Company, 1936.

The second edition of this worthwhile work now appears in one volume. The text has been revised, and in some sections has been rewritten.

It has been the author's purpose to provide a manual to which the surgical practitioner can turn when he must deal with an acute emergency. As the author says in the preface to the second edition, "When to operate, when not to operate, and how to operate under emergency conditions," is the theme.

Space does not permit us to list the many chapter headings, but every phase of emergency surgery is thoroughly covered.

The general makeup is excellent; the text is readable and plain and the illustrations valuable. The index is ample.

The man called, at times to meet surgical emergencies, even though he does not specialize in this field, might well linger through the pages of this work.

PARENTERAL THERAPY. By Walton Forest Dutton, M.D. and George Burt Lake, M.D. Illustrated with 90 half-tones and line engravings. Springfield, Ill., Charles C. Thomas, 1936.

The authors designated the title "Parenteral Therapy" because it is a designation including all therapeutic efforts brought to bear directly upon all methods of administration of medicaments except by the alimentary route. The physician, dentist, nurse, veterinarian or pharmacist, should he require a reference work from which he may secure such knowledge at a glance, has in this volume all that can be desired.

To give a brief idea of what the book covers a few chapter headings are listed: Technical Methods in Treatment, Intradermal Injections, Hypodermic Injections, Technic of Intramuscular Injections, Infusions of Physiologic Salt Solutions, General Technic of Intravenous Injections, Continuous Intravenous Injections, Intraperitoneal Injections, Transfusion of Blood, Methods of Collecting Blood and Serum, Intramuscular Injection of Whole Blood, Intracardiac Injections, Puncture of the Pericardium, Pneumothorax, Artificial, Cisternal Puncture; four chapters on anesthesia, intravenous, infiltration, caudal epidural and spinal; Alcohol Injection for Nerve Block, Varicose Veins (Technic in Obliterative Treatment), Injections Treatment of Hemorrhoids and Hernia, and Ionic Medication. There is a Therapeutic Index, and a Part devoted to Pharmacologic Notes.

For the one who is not familiar with these items of practice this will prove a valuable book.

HANDBOOK OF SURGERY. By Eric C. Mekie, M.B., F.R.C.S. (Edin.). With a Foreword by John Fraser, Regius Professor of Clinical Surgery, University of Edinburgh. Baltimore. William Wood and Company, 1936.

This book is of special interest to medical students. In his Preface the author states, "For several years it has been my privilege to conduct a class of preparat.on for the Final Examination in Surgery, and it is in response to the request of some of my former students, and now colleagues, that this book has been written. . . . It has been my aim to set down only what are the salient features of the subject which must be known ere the student presents himself for examination."

This compact book of 699 pages is a treasure house of surgical information. Designed for the medical student about to take his examinations, anyone who knows 60 per cent of what it offers would know more than the average surgeon about his specialty.

DIE PARASAGITTALEN MENINGIOME. By H. Olivecrona, Leipzig, G. Thieme, 1934.

In this monograph Olivecrona presents his personal experience in the diagnosis and treatment of 34 cases of parasagittal meningiomas. In a general way, he divides them into four groups, namely: those arising from (1) the

anterior, (2) the middle, (3) the posterior third of the superior longitudinal sinus, and (4) those arising from the falx. He supplements this with a chapter which orients the reader as to the place usually occupied by meningiomas among brain tumors, and another on the variable histopathologic appearances of these neoplasms.

All the case histories are presented, some in considerable detail. Then follows a chapter on symptomatology including the characteristic roentgen ray evidence of these tumors.

In another chapter devoted to diagnosis he attempts to establish a more or less characteristic syndrome for each of the four groups already mentioned. Thus the salient clinical features of the meningiomas arising from the anterior third of the longitudinal sinus are: (1) a long history usually initiated with headache, (2) psychotic manifestations, (3) a slight central facial weakness and (4) bilateral papilledema and often a homolateral hyposmia or an anosmia.

The meningiomas of the middle third of the longitudinal sinus give a very typical syndrome: (1) A long history of slowly progressive cortical monoparesis of the lower, but seldom the upper extremity, often punctuated by Jacksonian seizures. Sensory disturbances are frequent but seldom marked. (2) Signs of general pressure are seldom present except at a late stage.

Bone changes in the skull occur in about half the cases, but even without them the diagnosis is relatively easy.

The meningiomas arising from the posterior third of the longitudinal sinus present: (1) A long history usually of headache but often of a subjective homonymous visual field defect, and, if left-sided, of sensory aphasia; (2) homonymous hemianopia of varying degree but usually showing a sparing of the macula; (3) marked sensory disturbances, especially if the tumor is located in the anterior part of the posterior group; (4) sensory aphasia with alexia and agraphia in left-sided lesions.

Tumors arising from the falx may give similar symptoms to those resulting from sinus tumors in the corresponding third of the sinus except that the hyperostosis is usually absent. At times, however, the symptoms are quite atypical and ventriculography or arteriography becomes quite indispensible.

The last chapter is devoted to the surgical technique in dealing with these tumors. Some of the special points in the author's technique are worthy of mention. He prefers to make his bone flap across the midline instead of biting away the bone on the other side secondarily. He advocates cutting the dura all around the tumor, especially the portion between the tumor and sinus, since he feels that in this way less blood is lost than when that portion of dura is left to be cut later. Concerning the resection of the longitudinal sinus, he believes this is to be avoided even in the anterior portion whenever possible, unless the sinus is already obliterated by invasion of the tumor. He thinks it inconsequential whether the dural defect is closed or not. He considers drainage through a separate puncture hole in the scalp both safe and desirable. With improved hemostatic technique and multiple transfusions the operation can, as a rule, be completed in a single stage.

While the details in this book are too numerous to be summarized, it is obvious from what has been given that the author is an experienced neurosurgeon who shares his valuable experiences freely with his readers.

Passive Vascular Exercises and the Conservative Management of Obliterative Arterial Diseases of the Extremities. By Louis G. Herrmann, M.D. With a Foreword by Mont R. Reid, M.D. Illustrated with 80 engravings and 4 colored plates. Phila., J. B. Lippincott Company, 1936.

The purpose of Dr. Herrmann's book is best described by quoting from a passage on a fly-leaf: "The gradual rise and fall, in cyclic sequence, of air-pressure about the human extremities with the pressure predominantly in the phase *below* the existing atmospheric pressure constitutes the physical basis for Passive Vascular Exercises. Clinically and experimentally this type of alternation of the environmental air-pressure has been shown to constitute an efficient and truly physiological means of promoting the establishment of an adequate collateral arterial circulation in human extremities after the major or secondary arteries have been obliterated by trauma or by some disease."

The first chapter is devoted to an introduction, and this is followed by the Historical Development of Knowledge Concerning Physiologic Effects of Changes in Environmental

Air-pressure Upon Peripheral Arterial Circulation. Some of the other chapters deal with, The Physiology of the Peripheral Distribution of Blood, Physiologic Effects of Rhythmic Alternation of Environmental Air-pressure, Physiologic Effects of Changes in Environmental Temperature, The Collateral Arterial Circulation in Human Extremities, The General Management of Peripheral Vascular Disease, The Passive Vascular Exercise Method of Therapy, and Clinical Experiences with Passive Vascular Exercise Therapy. The last chapter is devoted to Routine for Study and Care of Patients with Organic Arterial Disease.

There is a part alloted to References; also, an Index.

Physicians who come in contact and treat arterial diseases of the extremities will do well to study this book.

THE PRACTITIONERS LIBRARY OF MEDICINE AND SURGERY. Volume X. Dermatology and Syphilology. New York, D. Appleton-Century Company, 1936.

This volume of 1043 pages is the tenth of a series published by Appleton-Century Company, each volume written by the outstanding specialists in their field. The supervising editor, George Blumer, M.D., of Yale, and C. Guy Lane, M.D., of Harvard, the associate editor, have done a splendid piece of work.

It is unnecessary to list the topics discussed but when one considers that such men as S. William Becker, Harold N. Cole, Joseph Jordon Eller, Clark W. Finnerud, Harry R. Foerster, Joseph V. Klauder, C. Guy Lane, Joseph Earle Moore, Paul A. O'Leary, Charles Robert Rein, Laurence R. Taussig, Eugene F. Traub, and Frederick D. Weidman are the contributors, it goes without saying the text is up to date and authoritative.

The subjects are thoroughly covered. The illustrations are ample and are a definite aid to the text. For those interested the Bibliography references are listed at the end of chapters. The Index is thorough.

STUDIES ON THE HEALING OF FRACTURES WITH SPECIAL REFERENCE TO THE SIGNIFICANCE OF THE VITAMIN CONTENT OF THE DIET. By John Hertz, M.D. Copenhagen, Levin & Munskgaard; London, Humphrey Milford (Oxford University Press), 1936.

The practitioner of medicine who, to any degree, is interested in the fracture problem will find this work instructive and authoritative, as well as interesting reading. It is one of those short books that are a joy and which appear only too seldom.

There are only 280 pages and 81 figures, many in color. Over the figures done in black and white are attached transparent sheets upon which are done line outlines upon which are the necessary numbers and letters by which the legends are made clear. All in all, it is beautifully done, and although issued in paper covers, the publishers are to be commended for both publishing the book and for the excellent way they have brought it out.

Part 1 has chapters on the Historical Survey, The Fracture Forceps, and the Hansen-Haggqvist Syncytial Theory.

Part 2 deals with ten chapters on the Author's Investigations. These chapters, in part, cover Technique, Healing of Fractures in Normal Guinea-Pigs, in Scorbutic Guinea-Pigs . . . Israel and Frankel's Refracture Experiments, Healing of Fractures in Normal Rats, and Rats on a Vitamin B-Deficient Diet, on a Vitamin A-Free Diet, Healing of Fractures in Rachitic Rats and in Rats on a Vitamin A and D-Free Diet, and in Rats Treated with Toxic Doses of Vitamin D. A chapter is devoted to Conclusions. There is an ample Bibliography.

SURGICAL EMERGENCIES IN CHILDREN. By Harold Clifford Edwards, M.S., London. Baltimore, William Wood and Company, 1936.

This small book may well be seriously read by many surgeons as emergency surgery in children is a field in itself. For the most part it has been a more or less neglected subdivision of surgery, therefore, Dr. Edwards' book is timely.

The author considers General Principles, Pyogenic Infections, Fractures, Injuries to Muscles and Tendons, Acute Infections of Bones and Joints, Head Injuries, Acute Disorders in the Abdomen, Injuries to the Abdomen, Inflammatory Conditions in the Abdomen, Acute Intestinal Obstruction, Congenital Malformations of the Intestinal Tract, including Meckel's Diverticulum, The Thorax, The Urinary and Genital Tracts, and The Ear, Nose and Throat (this chapter by Geoffrey H. Mateman, F.R.C.S.). The book of 274 pages is well indexed and illustrated.

It is recommended.